(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 714 204 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
09.01.2002 Bulletin 2002/02

(51) Int Cl.7: **H04N 5/913**

(21) Application number: **95308493.6**

(22) Date of filing: **27.11.1995**

(54) **Illegal view and copy protection method in digital video system and controlling method thereof**

Verfahren zum Schutz vor unerlaubtem Kopieren und Sehen in einem digitalen Fernsehsystem und Steuerverfahren dazu

Méthode de protection contre la vue illégale et la copie dans un système vidéo numérique et méthode de commande à cet effet

(84) Designated Contracting States:
DE FR GB

(30) Priority: **26.11.1994 KR 9431364**

(43) Date of publication of application:
29.05.1996 Bulletin 1996/22

(73) Proprietor: **LG ELECTRONICS INC.**
Seoul (KR)

(72) Inventor: **Park, Tae Joon**
Seoul (KR)

(74) Representative:
McLeish, Nicholas Alistair Maxwell et al
Boult Wade Tennant Verulam Gardens 70 Gray's Inn Road
London WC1X 8BT (GB)

(56) References cited:
EP-A- 0 267 039
EP-A- 0 519 320
EP-A- 0 588 535
US-A- 5 455 860

EP 0 714 204 B1

Printed by Jouve, 75001 PARIS (FR)

Description

Background of the Invention

[0001] The present invention relates to an illegal view and copy protection technique for a digital video system, and more particularly, to an illegal view and copy protection method in a digital video system for preventing an illegal user from viewing the digital video system and copying therefrom, by setting a descrambling method which decrypts split keystreams adopting a smart card.

[0002] In a general digital video system, there has been a keen interest in implementing a conditional access (CA) system for an illegal viewing protection.

[0003] In such a CA system, a broadcasting signal is scrambled at charged channels such as in a cable television or a satellite broadcasting service to be broadcasted. Therefore, only a user who paid normally can view a program properly through descrambling.

[0004] For example, a satellite broadcasting receiver or a Grand Alliance (GA) system, which is a standard of an advanced television (ATV) in U.S.A. has a function for supporting a CA. Also, scrambling/descrambling apparatus, such as a video cipher manufactured by GI, which can be used for a satellite broadcasting, have been commonly used.

[0005] Video cipher manufactured by GI is generally used for the scrambling system for a CA system, which is based in U.S. Patent No. 4,613,901 by Gilhousen, disclosing a system and method, in which a TV signal transported via a normal user's descrambler is scrambled in a charged TV system to be broadcasted and then is selectively descrambled in the user's descrambler. A video cipher system for performing a descrambling is implemented by adopting a smart card, which is disclosed in U.S. Patent No. 5,111,504. This is implemented such that the system proposed by Gilhousen is partitioned into two parts, that is, an information processor corresponding to a descrambler and a security element which can be replaced by a smart card.

[0006] Therefore, by adopting the above method, the scrambling system is implemented as shown in FIG. 1, and the descrambling system is implemented as shown in FIG. 2.

[0007] In other words, a conventional illegal viewing protecting apparatus for a digital video system includes a scrambler 101 for scrambling a TV signal in accordance with a common category key (CK) and an initialization vector (PK) and outputting the scrambled TV signal (SV_o) and scrambling information $E_{U(D)}E_{U(S)}(CK)$ and $E_{CK}(PK)$, a smart card 103 for encrypting information for descrambling, A(D) and A(S), with respect to descrambling information U(S), and an information processor 102 for decrypting the information for descrambling, $E_{A(D)}[E_{A(S)}(WK)]$, to descramble the TV signal (SV_o) transported from scrambler 101 and restoring the same into original TV signal DV_o.

[0008] Here, A(D) is an authentication key of information processor 102, A(S) is an authentication key of smart key 103, U(D) is a unit key of information processor 102, and U(S) is a unit key of smart key 103.

[0009] At this time, scrambler 101 includes a first encrypter 111 for encrypting a common category key (CK) with respect to descrambling information U(D) and U(S), a second encrypter 112 for encrypting an initialization vector (PK) with respect to the common category key (CK), a third encrypter 113 for encrypting the initialization vector (PK) with respect to the output $E_{CK}(PK)$ of second encrypter 112, and a scrambling executing party 114 for scrambling a TV signal V_i in accordance with the output WK of third encrypter 113.

[0010] The operation of the conventional apparatus having the aforementioned configuration will now be described.

[0011] First, in the case of transporting a TV signal in a transport system, scrambler 101 operates such that the common category key (CK) is encrypted with respect to the descrambling information U(D) and U(S) by first encrypter 111, the initialization vector (PK) is encrypted with respect to the common category key (CK) by second encrypter 112, the initialization vector (PK) is encrypted with respect to the output $E_{CK}(PK)$ of second encrypter 112 by third encrypter 113, to then be output to scrambling executing party 114.

[0012] At this time, scrambling executing party 114 scrambles the TV signal V_i in accordance with the output WK of third encrypter 113. Here, the scrambling information WK is expressed in $E_{ECK(PK)}(PK)$.

[0013] Accordingly, scrambler 101 transports information $E_{U(D)}$ $E_{U(S)}(CK)$ encrypted with respect to the common category key (CK), the information $E_{CK}(PK)$ encrypted initialization vector (PK) and the scrambled TV signal SV_o, to information processor 102.

[0014] In case of descrambling the scrambled TV signal SV_o, smart card 103 encrypts the information WK necessary for descrambling with respect to authentication information A(D) of information processor 102 and its own authentication information A(S), and then generates the encrypted descrambling information $E_{A(D)}[E_{A(S)}(WK)]$ to information processor 102.

[0015] Accordingly, information processor 102 decrypts the encrypted descrambling information $E_{A(D)}[E_{A(S)}(WK)]$ generated from smart card 103 and descrambles the TV signal SV_o transported from scrambler 101 using the encrypted descrambling information $E_{A(D)}[E_{A(S)}(WK)]$, thereby restoring the same into the original TV signal DV_o.

[0016] Here, the encryption in transporting the information between information processor 102 and smart card 103 is adopted for enhance the security from the illegal view and copy.

[0017] For example, the specification of a GA-HDTV system supports the CA system and includes various functions necessary for transport protocols.

[0018] These functions are flexible and useful in that they support all possible descrambling methods and key

encryption methods, and bitstreams are selectively scrambled so that a CA function can be adopted in the unit of an element stream.

[0019] Here, the scrambling randomizes data bitstream according to information data, and the encryption converts information data in order to protect the information data from illegal users.

[0020] In other words, the CA system makes the transported data random and disables the illegal users' decoders to be decoded improperly by means of a scrambler but allows the legal users' decoders to decode the received TV broadcasting signals properly by supplying information for initializing a descrambler circuit.

[0021] The CA transport MPEG protocol for such operation is implemented by the format shown in FIG. 3 and supports the CA function as follows.

[0022] First, a transport-scrambling-control field of 2 bits notifies whether or not a transport stream is scrambled and which scrambling key is used.

[0023] Second, each data is inserted into the GA transport system using a transport-private-data field positioned within adaptation header of the transported stream, and encrypted scrambling information is stored in the field.

[0024] The CA transport MPEG protocol transports a transport header, a packetized elementary stream (PES) and audio and video data independently or concurrently. The transport protocol includes a header link header region, an adaptation header region and a payload region.

[0025] Here, the link header has a length of 4 bytes and the adaptation head has a variable length.

[0026] The transport-scrambling-control field is inserted into the link header. A field value of "00" is recognized as being not scrambled, "10" is recognized as being an even key, "11" is recognized as being an odd key, and "01" is recognized as being reserved.

[0027] The adaptation header includes a flag bit and transport-private-data field, and the flag bit includes transport-private-data flag of one bit. The PES header of the CA transport MPEG protocol shown in FIG. 3 is constructed as shown in FIG. 4.

[0028] A field for a digital storage media (DSM) such as a digital video cassette recorder (DVCR) exists in the PES header. Such a field include a PES header flag region having a length of 14 bits and a PES header field having a variable length. The PES header flag region includes a 1-bit copyright (CR) flag, a 1-bit original-or-copy flag, a 2-bit PD flag, a 1-bit TM flag and a 1-bit AC flag.

[0029] The PES header field has a variable length and its region is partially set by the PD, TM and AC flags contained in the PES header flag region.

[0030] In other words, PTS/DTS regions do not exist in the PES header field if the PD flag value is "00," PTS/DTS of 40 bits exist if the PD flag value is "10," PTS/DTS of 80 bits exist if the PD flag value is "11." A DSM trick mode does not exist if the TM flag value is "0," and the DSM trick mode becomes 8 bits if the TM flag value is "1." Also, if the AC flag is set to "1," an additional copy information field becomes 8 bits.

[0031] The scrambling information is transported by adopting the above-described format, and the descrambling process using the information is shown in FIG. 5.

[0032] Here, since the descrambling system decrypts the next encrypted key together with the key being used for the current descrambling, the descrambler stores at least two keys, that is, an odd key and an even key.

[0033] Also, the scrambling system sets a value of the transport-scrambling-control field within the link header according to the descrambling method of the current transport stream to then transport the same.

[0034] Accordingly, the descrambler determines an even key or an odd key according to the value of the transport-scrambling-control field of the decrypted transport head from the received data and then descrambles the received data to then be decrypted.

[0035] In other words, when the data having the format shown in FIG. 5 is transported and descrambler descrambles the K_{2n-1}-th frame with the odd key according to the value of the transport-scrambling-control field decrypted in smart card, smart card decrypts the transport-scrambling-control field of K_{2n}-th frame to be descrambed next. These operations are sequentially performed.

[0036] An ATV decoder for performing the CA function may be implemented as shown in FIG. 6. The ATV decoder 110 incorporates a descrambler necessitating a fast operation into a transport demultiplexer 105 and performs the descrambling by a DES algorithm or a stream cipher algorithm using a PN sequence. The key encrypted by ATV decoder 110 is decrytped in smart card 103. Here, the interface between smart card 103 and ATV decoder 110 is executed in accordance with the ISO-7816 standard specification.

[0037] In other words, in the arrangement shown in FIG. 6, a signal received from a tuner is demodulated in a demodulator & error corrector 104 and then the errors generated during transport are corrected by an RS decoding and are input to transport demultiplexer 105 of ATV decoder 110 to then be descrambled.

[0038] At this time, a microcontroller 109 operates descrambled control and data and transports the encryption information for descrambling to smart card 103. Smart card 103 decrypts the transported encryption information to transport the same to ATV decoder 110.

[0039] At this time, transport demultiplexer 105 restores a compressed video and audio signals, control signal and data according to the descrambling information.

[0040] Accordingly, a video decoder 107 extends the compressed video signal and temporarily stores the extended signal in a memory 106 and then outputs the stored data to display a video. An audio decoder 108 extends the compressed audio signal and then repro-

duce an audio.

[0041] Also, microcontroller 109 reads the control signal and data output from transport demultiplexer 105 and controls the operations of video decoder 107 and audio decoder 108.

[0042] Among various methods used for encryption, a blockcipher algorithm such as DES and a stream-cipher algorithm using the PN sequence are most widely used.

[0043] However, since these methods perform encryption and decryption only with a encrypted signal, a key management and a key distribution are hard to accomplish.

[0044] Therefore, in order to solve the above problem, a public key encryption method has been proposed in U.S. Patent No. 4,200,770. This method performs encryption using a public key and performs decryption using his own secret key.

[0045] The public key encryption method has been improved and implemented as an encryption system, which is known as an RSA encryption algorithm disclosed in U.S. Patent No. 4,405,829. However, this public key encryption method is not suitable for fast encryption.

[0046] The CA system aims to protect an illegal viewing. However, programs distributed through a DSM such as a DVCR cannot be protected from the illegal copying.

[0047] In other words, the protection of the program distributed by a recording medium such as DSM means the illegal copying protection. However, the copy protection method adopted in a conventional analog VCR system is difficult to be adopted in a digital storage media. Also, research into the copy protection method for DSM has not yet been developed well.

Summary of the Invention

[0048] Preferred and particular embodiments of the present invention, which is defined in its broadest aspect in claim 1, seek to address the problems of the prior art and provide illegal view and copy protection method in a digital video system and a controlling method thereof for protecting illegal view and copy, in which encrypted key is decrypted in a smart card by transporting a scrambled bitstream and the encrypted key used for scrambling to different paths and the bitstream is descrambled in accordance with the information, and normal decoding is not performed only by the bitstream.

[0049] Further embodiments of the present invention adopt a smart card in the CA system so that the charge is automatically checked to enforce the pay per view (PPV) function and to upgrade the performance of the system by adding various functions by way of replacement of the smart card.

[0050] Still other embodiments of the present invention reduce the key quantity of the data to be protected greatly by splitting the transported data and to make the system inoperative with an illegal smart card by automatic performance of authentication and key exchange during power-on or connection to a digital recording /reproduction device for recording, thereby increasing the reliability of the protection function.

[0051] The present invention provides an illegal view and copy protection method in a digital video system, including: a determination step for determining whether received data has been scrambled; a reproduction step, if the received data was determined to be scrambled data in the determination step, splitting the scrambled data into a bitstream and a keystream for decrypting the split keystream for reading in key information, and descrambling the split bitstream according to the read in key information for displaying the bitstream on a display; a recording step for, if the received data was determined to be scrambled data in the determination step, recording the scrambled data on a recording medium either as scrambled data of a bitstream and a keystream according to a recording or copying mode, or after splitting the scrambled data into a bitstream and a keystream, encrypting the split keystream, and mixing the encrypted keystream with the bitstream; and a transporting step, if the received data was determined to be scrambled data in the determination step, splitting the scrambled data into a bitstream and a keystream for transporting the split keystream either after decrypting the split keystream with respect to key information from recording side according to a PPC mode or a back-up copy mode, or after decrypting the split keystream two times with respect to key information contained therein and key information from recording side, thereby the reproduction step, the recording step and the transporting step can be performed simultaneously or selectively.

[0052] Embodiments of the invention provide an illegal view and copy protection method in a digital video system, including: a reproduction step, on reception of scrambled data, splitting the scrambled data into a bitstream and a keystream for decrypting the split keystream for reading in key information, and descrambling the split bitstream according to the read in key information for displaying the bitstream on a display; and a recording step for, on reception of scrambled data, recording the scrambled data on a recording medium as scrambled data of a bitstream and a keystream; thereby the reproduction step and the recording step can be performed simultaneously or selectively.

[0053] Embodiments of the invention also provide an illegal view and copy protection method in a digital video system, including: a determining step for determining the mode of the keystream being a back-up copy mode or a PPC mode; a first transportation step for, if the mode was determined to be a PPC mode in the determining step, decrypting the keystream with respect to key information from a recording side for transporting the keystream; a first recording step for encrypting the keystream transported in the first transportation step with respect to the key information from the recording side and inserting the encrypted keystream into a position

corresponding to an index code, for recording the keystream together with a bitstream on a recording medium; a second transportation step for, if the mode was determined to be a back-up copy mode in the determining step, decrypting the keystream for two times with respect to its own key information and the key information from the recording side for transporting the keystream; and a second recording step for encrypting the keystream transported in the second transportation step with respect to the key information from the recording side and inserting the encrypted keystream into the position corresponding to the index code, for recording the keystream together with the bitstream on a recording medium.

[0054] Embodiments of the invention also provide an illegal view and copy protection method in a digital video system, including: a 'PPC' mode reproduction step for, having determined the recording medium being a 'PPC' recording medium on detection of a keystream at reproduction from a recording medium, encrypting the keystream with respect to its own key information and decrypting the keystream with respect to its own key information for reading in the key information, for descrambling the bitstream using both the read in key information and an index code; and a 'back-up copy' mode reproduction step for, having determined the recording medium being a 'back-up copy' recording medium on detection of a keystream decrypted with respect to its own key information at reproduction from a recording medium, encrypting the keystream for two times with respect to its own key information and the key information from a recording side and decrypting the keystream with respect to its own key information for reading in the key information, for descrambling the bitstream using both the read in key information and an index code.

[0055] Embodiments of the invention also provide an illegal view and copy protection device in a digital video system, including: demodulating & error correcting means for modulating /demodulating an analog broadcasting signal and RS-decoding said signal; copy protection processing means for transporting the output of said demodulating & error correcting means to a digital recording/reproduction device, splitting the scrambled recording signal reproduced from said digital recording/reproduction device into a bitstream and a keystream, and encrypting the split keystream; decoding means for descrambling the bitstream from said demodulating & error correcting means or the copy protection processing means according to descrambling information; and a smart card for decrypting the encrypted keystream of said copy protection processing means for applying to said decoding means as descrambling information.

[0056] Embodiments of the invention also provide an illegal view and copy protection device in a digital video system, including: first copy protection processing means for splitting reproduction data from a first digital recording /reproduction device into a bitstream and a keystream and encrypting the split keystream; first and second smart cards for decrypting encrypted keystream from said first copy protection processing means with respect to its own key information and the key information from a recording side; and second copy protection processing means for encrypting the keystream from the first smart card transported through the second smart card with respect to its own key information and transporting the encrypted keystream together with the split bitstream to a second digital recording/reproduction device, for recording on a recording medium.

[0057] In a preferred embodiment, the copy protection processing means includes a RAM for storing intrinsic key information of the smart card, an algorithm storage memory for storing an encryption algorithm, and a processor for executing an encryption program of the algorithm storage memory with the key information of the RAM.

[0058] Aforementioned copy protection processing means includes a CA function as well as an all round program copyright protection function inclusive of illegal viewing protection and illegal copying protection.

[0059] In a preferred embodiment, the smart card includes a first algorithm storage memory for storing a decryption algorithm program for a bitstream, a second algorithm storage memory for storing a decryption algorithm program of its own key information, a ROM for storing its own key information, and a RAM for temporarily storing key information of another smart card.

Brief Description of the Drawings

[0060] The above objects and advantages of the present invention will become more apparent by describing in detail a preferred embodiment thereof with reference to the attached drawings in which:

FIG. 1 is a block diagram of a general scrambler;
FIG. 2 is a block diagram of a general descrambler;
FIG. 3 illustrates a transport format;
FIG. 4 illustrates a PES header shown in FIG. 3 in detail;
FIG. 5 illustrates the transport format by key distribution;
FIG. 6 is a block diagram of a conventional ATV decoder;
FIG. 7 is a block diagram of an illegal view and copy protection apparatus embodying the present invention;
FIG. 8 is a detailed block diagram of the copy protection apparatus shown in FIG. 7;
FIG. 9 is a detailed block diagram of the smart card shown in FIG. 7;
FIG. 10 illustrates the splitting of the bitstream shown in FIG. 8;
FIG. 11 illustrates the format of the respective bitstreams;
FIGS. 12 through 18 illustrate the connections state of a preferred embodiment of the present invention;

FIGS. 19 and 20 show the flow of signals for operation of a preferred embodiment of the present invention; and

FIG. 21 shows the flow of signals for key exchange and authentication according to a preferred embodiment of the present invention.

Detailed Description of the Invention

[0061] The present invention is applicable to all recording/reproduction devices that can record and reproduce a digital signal, and for the sake of convenience of explanation, descriptions shown hereinafter is for an embodiment in a case of DVCR, as an example.

[0062] Accordingly, as shown in FIG. 7, the illegal view and copy protection apparatus in a digital video system according to an embodiment of the present invention, includes a demodulator & error corrector 1 for modulating/demodulating an analog broadcasting signal and RS-decoding the signal, an ATV decoder 2 for descrambling the output of demodulator & error corrector 1 according to descrambling information, a copy protection processor 4 for splitting the scrambled recording signal into a bitstream and a keystream and encrypting the split keystream, and a smart card 3 for decrypting the split and encrypted keystream of copy protection processor 4 and the index code of ATV decoder 2 and outputting descrambling information KS to ATV decoder 2.

[0063] Copy protection processor 4, as shown in FIG. 8, includes a RAM 17 for storing intrinsic key information of the smart card, an algorithm storage memory 18 for storing an encryption algorithm, and a processor 19 for executing an encryption program of algorithm storage memory 18 with the key information of RAM 17.

[0064] Smart card 3, as shown in FIG. 9, includes a first algorithm storage memory 12 for storing a decryption algorithm program for a bitstream, a second algorithm storage memory 13 for storing a decryption algorithm program of its own key information, a ROM 14 for storing its own key information, a RAM 15 for temporarily storing key information of another smart card, and a processor 11 for executing encryption or decryption with the storage algorithm of first and second algorithm storage memories 12 and 13 with respect to the key information stored in ROM 14 or RAM 15.

[0065] At this time, processors 11 and 16 may be constructed by wired logic or may adopt a microprocessor. In case of adopting the microprocessor, the encryption algorithm for a smart card may be incorporated in a program.

[0066] The operation and effect of the embodiment constructed as stated above will now be described.

[0067] In the described embodiment, a GA bitstream is transported in the format as shown in FIGS. 11A through 11C, in which FIG. 11A shows a unscrambled format, FIG. 11B shows a scrambled format with respect to a bitstream, and FIG. 11C shows a format in which the bitstream is selectively scrambled.

[0068] In the described embodiment, if the GA bitstream is scrambled, it is assumed that a protection of any kind will be applicable.

[0069] Therefore, if scrambled stream data $S_{KS}(BS)+E^{G}(KS)$ of the format shown in FIG. 11B or 11C is input to copy protection processor 4, a splitter shown in FIG. 10 splits the stream data into bitstreams $S_{KS}(BS)+IDX$ and keystreams $E^{G}(KS)$. Then, a recording mode is performed to encrypt again the split keystreams $E^{G}(KS)$ to then be transported to smart card 3.

[0070] Here, as shown in FIG. 11C, if the bitstreams are partially scrambled, the illegal view and copy protection function is adoptable only to the scrambled portion, thereby performing a partial protection function.

[0071] First, when non-scrambled bitstreams are transported as shown in FIG. 11A, even if the bitstreams modulated/demodulated and decrypted in demodulator & error corrector 1 are input to copy protection processor 4, the data is not transported to smart card 3. Either, ATV decoder 2 to which the bitstreams of demodulator & error corrector 1 are input does not transport the data to smart card 3 but decrypts the bitstream.

[0072] Therefore, there is no restriction in view and copy.

[0073] Here, the signal input from a tuner to demodulator & error corrector 1 and the video and audio signals output from ATV decoder 2 are analog signals. The signal output from tuner is a VSB-modulated signal from the GA-bitstream.

[0074] Among input/output signals, bitstreams and keystreams are digital signals for DVCR.

[0075] At this time, if the recording is performed, the bitstreams are recorded onto DVCR and the recorded bitstreams are played back from a general DVCR.

[0076] In other words, even if non-scrambled MPEG bitstreams are input to copy protection processor 4 and passes through splitter as shown in FIG. 10, there is no data transported to smart card 3 due to no key information, thereby allowing a free view and copy.

[0077] Also, when the recording or copy protection functions are executed in the present invention, the split bitstreams and keystreams are transported to different lines from each other. The information on the copy protection method is transported with an additional copy information field within the PES header.

[0078] At this time, even if the scrambled bitstreams having no encrypted key are transported to an illegal user of the public channels, the descrambling is not executed properly in the state where the key information is removed.

[0079] Also, the split key is again encrypted to be transported. Thus, if there is no decryption algorithm, bitstreams cannot be descrambled.

[0080] Therefore, in the described embodiment, an arbitrary field is used in the MPEG transport protocol for the illegal view and copy protection, in which scrambling-executed bitstreams adopts the copy protection

function.

[0081] First, if transport-scrambling-control field is changed into a "not-scrambled" mode, ATV decoder 2 does not execute descrambling, so that the illegal user cannot operate the field.

[0082] In such copy protection method, copy protection or free-copy function is determined by the transport-scrambling-control field. Therefore, the illegal user cannot release the copy protection function only by manipulating the field.

[0083] Next, the illegal user may modify the additional copy information field within the PES header, which converts the protection method. This method does not remove the protection method itself, which does not cause a noticeable damage to the copy protection function.

[0084] The copy protection method supported by the embodiment having the above features includes a "no copy" method, a "pay-per-copy (PPC)" method, and a "back-up copy" method, with the default of a pay-per-view (PPV) function and a pay-per-play (PPP) function.

[0085] Here, the "no copy" method makes it completely difficult to copy with another video tape. The "PPC" method is to pay per one copy. The "back-up copy" method allows a video tape played back from a first DVCR and copied from a second DVCR to be displayed normally only in the first DVCR but not in the second DVCR.

[0086] A copy protection method embodying the present invention and the flow of the corresponding MPEG bitstreams will now be described with reference to FIGS. 19 through 21.

[0087] Here, FIG. 19 shows the flow of signals for operation of the copy protection processor during recording or playback mode, FIG. 20 shows the flow of signals for operation of the smart card corresponding to the copy protection processor, and FIG. 21 shows the flow of signals for key exchange and authentication during recording or playback operation.

[0088] First, referring to FIG. 19A, copy protection processor 4 to which bitstreams are input checks the presence or absence of key information to determine whether it is scrambled or not, and determines whether the recording is the first recording or the copy recording if the key information is scrambled (S101). In other words, in the case of scrambled data, it is detected whether the data is transported in the streams of S_{KS} (BS)+IDX format by splitting the data into bitstreams S_{KS} (BS) and keystreams $E^G(KS)$. If the streams of S_{KS}(BS) +IDX format are detected, the recording is determined to be the copy recording. If not detected, the recording is determined to be the first recording (S102).

[0089] Accordingly, if the recording is determined to be the first recording, the mixed streams $S_{KS}(BS)+E^G$ (KS) of bitstreams and keystreams are recorded onto a tape (S106). If the recording is determined to be the copy recording, the bitstreams $S_{KS}(BS)$+IDX with keystreams $E^G(KS)$ split, are transported to copy protection processor 8 of recording side and the keystreams E^G (KS) are again encrypted with respect to the key information Ak (S105). Then, the encrypted keystreams $E_{SC}{}^{AK}[E^G(KS)]$ are transported to smart card 7 of recording side via smart card 3, thereby allowing the recording onto the tape in a VCR 9 of recording side (S106).

[0090] On the contrary, FIG. 19B shows the signal flow in the case of the playback of the recorded tape with the same signal flow as shown in FIG. 19A, in which copy protection processor 4 splits and determines keystreams (S108) if bitstreams played back from VCR are input (S107), thereby determining whether the recording function is a "back-up copy" or not (S110).

[0091] At this time, in step S110, the tape is determined as a general recording tape, if there is no key information, and the tape is determined as the first recording tape if encrypted keystreams $E^G(KS)$ are detected. Also, if the keystream $D_{SC}{}^{Ak}[E^G(KS)]$ encrypted with respect to its own key information Ak, the tape is determined as the recording tape of PPC function. If the keystream $D_{SC}{}^{Al}[E^G(KS)]$ encrypted with respect to the key information Al of another smart card, the tape is determined as the recording tape of back-up copy function.

[0092] Accordingly, copy protection processor 4 transports to ATV decoder 2 the bitstream (BS) in the case of a general recording tape, and the bitstream S_{KS} (BS)+IDX with keystreams $E^G(KS)$ split in the case of the recording tape of back-up copy function (S109).

[0093] Copy protection processor 4 transports to smart card 3 the encrypted keystream $D_{SC}{}^{Ak}[E^G(KS)]$ encrypted twice by the encryption algorithm $E^{SC}{}_{AK(\cdot)}$ with respect to its own key information Ak if the back-up copy function is adopted during the playback of the recording tape of copy protection function (S111, S112 and S113). Also, copy protection processor 4 transports to smart card 3 the encrypted keystream $E_{SC}{}^{Ak}[E^G(KS)]$ obtained by encrypting keystream $E^G(KS)$ by the encryption algorithm $E^{SC}{}_{AK(\cdot)}$ with respect to its own key information Ak if the back-up copy function is not adopted (S112 and S113).

[0094] While the above-described operations are performed by copy protection processor 4, smart card 3 performs the operations of the signal flow as shown in FIG. 20. To be detail, smart card 3 determines whether an index code IDX or keystream $E^G(KS)$ is input from ATV decoder 2 or not, by performing broadcasting or playback operation (S114 and S115).

[0095] At this time, if the keystream $E^G(KS)$ is input instead of the index code IDX, smart card 3 having determined the broadcasting view of PPV function decrypts the keystream $E^G(KS)$ by decryption algorithm $D^G(\cdot)$ with respect to the bitstream GA (S116) and inputs the key information KS to ATV decoder 2 (S117).

[0096] Accordingly, ATV decoder 2 reads the key information KS of smart card 3, determines a descrambling method and descrambles the bitstream $S_{KS}(BS)$ to output analog video and audio signals, thereby allowing a viewer to watch the broadcasting program.

[0097] If it is determined that the index code IDX is

input in S115, smart card 3 decrypts the keystream $E_{SC}^{Ak}[E^G(KS)]$ input from copy protection processor 4 by decryption algorithm $D^{SC}_{AK(\cdot)}$ with respect to the key information Ak (S118) and then determines whether the operation is a playback operation or a recording operation (S119).

[0098] At this time, if it is determined that the operation is the playback operation in S119, smart card 3 decrypts the keystream $E^G(KS)$ by decryption algorithm $D^G(\cdot)$ with respect to the bitstream GA (S116) and inputs the key information KS to ATV decoder 2 (S117).

[0099] Accordingly, ATV decoder 2 reads the key information KS of smart card 3, determines a descrambling method and descrambles the bitstream $S_{KS}(BS)$ split in copy protection processor 4 by the determined descrambling method to output analog video and audio signals, thereby allowing a viewer to watch the recorded program of the tape.

[0100] If it is determined that the operation is the recording operation in S119, smart card 3 determines whether the function is the back-up copy function or not (S120). If the function is the back-up copy function, the keystream $E^G(KS)$ by decryption algorithm $D^{SC}_{Ak(\cdot)}$ with respect to the key information Ak (S121), and then the decrypted keystream $D^{SC}_{Ak}[E^G(KS)]$ by decryption algorithm $D^{SC}_{Ak(\cdot)}$ with respect to the key information Al (S122).

[0101] At this time, the keystream $D^{SC}_{Ak}\{D^{SC}_{Al}[E^G(KS)]\}$ decrypted in smart card 3 is transported to recording side (S123) and is input to copy protection processor 8 through smart card 7 (S124) to then be encrypted by encryption algorithm $E^{SC}_{Al(\cdot)}$.

[0102] Accordingly, smart card 7 inserts the encrypted keystream $D^{SC}_{Ak}[E^G(KS)]$ into a position designated by the index code IDX and mixes the same with the bitstream $S_{KS}(BS)$ output from copy protection processor 4 of playback side to then be recorded onto the tape in VCR 9.

[0103] If it is determined that the operation is the recording operation in S119, and it is determined in S120 that the PPP function is adopted, instead of the back-up copy function), smart card 3 decrypts the keystream $E^G(KS)$ by decryption algorithm $D^{SC}_{Al(\cdot)}$ with respect to the key information Al (S122) and transports the decrypted key information $D^{SC}_{Al}[E^G(KS)]$ to recording side (S123).

[0104] At this time, copy protection processor 8 of recording side, having received the keystream $D_{SC}^{Al}[E^G(KS)]$ through smart card 7 encrypts the received keystream $D_{SC}^{Al}[E^G(KS)]$ by the encryption algorithm $E^{SC}_{Al(\cdot)}$ and inserts the encrypted keystream $[E^G(KS)]$ into a position designated by the index code IDX, thereby mixing with the bitstream $S_{KS}(BS)$ output from *copy* protection processor 4 of playback side. Therefore, the bitstream $S_{KS}(BS)+E^G(KS)$ output from copy protection processor 8 is recorded onto the tape by VCR 9.

[0105] As described above, in the preferred embodiment, all smart cards have common algorithm and common key with respect to encryption algorithm $E^G(\cdot)$ and decryption algorithm $D^G(\cdot)$ for the MPEG bitstream.

[0106] Also, the encryption algorithm $E^{SC}_{Al(\cdot)}$ and decryption algorithm $D^{SC}_{Ak(\cdot)}$ for a smart card are common for all smart card. However, key information is different for the respective smart cards.

[0107] In other words, each smart card contains an authentication key corresponding to its own identification (ID) in itself.

[0108] In performing such operation, the initialization including an authentication process for identify their counterpart between the copy protection processor and the smart card, and between the smart cards and a key exchange process is necessary.

[0109] At this time, as the authentication process, there has been proposed various methods such as a method of using symmetrical key algorithm like a DES algorithm, a method of using a public key algorithm like an RSA, or a method of using Fiat-Shamir (FS) scheme.

[0110] In the described embodiment, the public key algorithm is used in the authentication process and the key exchange method are illustrated in FIG. 21. Such methods are adopted on the basis that a public key (n, e) is shared by a key reception means 201 and a key transport means 202.

[0111] At this time, key reception means 201 is a copy protection processor or a smart card 1 of recording side, and key transport means 202 is its own smart card k.

[0112] The embodiment of the present invention operating as shown in the above flowchart will now be described with reference to FIGS. 12 through 18.

[0113] In the embodiment as shown in FIG. 11A, if non-scrambled bitstream BS is transported, the circuit operates as shown in FIG. 12. Therefore, the bitstream modulated/demodulated and RS-decoded in demodulator & error corrector 1 is decrypted in ATV decoder 2, thereby outputting analog video and audio signals.

[0114] At this time, during recording operation, the bitstream BS output from demodulator & error corrector 1 is recorded onto the tape in VCR 5 through copy protection processor 4. During playback operation, the bitstream BS played back from VCR 5 is input to ATV decoder 2 through copy protection processor 4 and is decrypted, thereby outputting analog video and audio signals.

[0115] In other words, since the data is not generated from copy protection processor 4 to smart card 3, the view and copy are not affected.

[0116] As shown in FIGS. 11B and 11C, if scrambled bitstream is input, the CA function is adopted to perform the operations shown in FIGS. 13 through 18.

[0117] First, in case of performing the PPV function, the circuit operates as shown in FIG. 13. That is to say, if scrambled bitstream $S_{KS}(BS)$ and encrypted keystream $E^G(KS)$ are transported, demodulator & error corrector 1 demodulates the modulated input signal and then corrects the errors generated during transport through RS-decoding.

[0118] At this time, ATV decoder 2 splits the key-

stream $E^G(KS)$ from the output $S_{KS}(BS)+E^G(KS)$ of demodulator & error corrector 1 and outputs the same to smart card 3. Then, smart card 3 decrypts the encrypted keystream $E^G(KS)$ and outputs again the keystream KS to ATV decoder 2.

[0119] Accordingly, ATV decoder 2 reads the key information KS of smart card 3, determines a descrambling method and descrambles the bitstream $S_{KS}(BS)$ to output analog video and audio signals.

[0120] As described above, smart card 3 shown in FIG. 9 allows processor 11 to decrypt the encrypted keystream $E^G(KS)$ and to output the decrypted keystream KS to ATV decoder 2 by decryption algorithm $E^G(\cdot)$.

[0121] In the case of recording scrambled bitstream for the first time, the circuit operates as shown in FIG. 14, in which the transported bitstream $S_{KS}(BS)+E^G(KS)$ is errorcorrected in demodulator & error corrector 1 through RS-decoding and then is input to VCR 5 through copy protection processor 4 to then be recorded onto the tape.

[0122] In the case of playing back the bitstream recorded as described above, if the function is PPP function, the system operates as shown in FIG. 15. If the bitstream $S_{KS}(BS)+E^G(KS)$ played back from VCR 5 is input to copy protection processor 4, copy protection processor 4 splits the played-back bitstream $S_{KS}(BS)+E^G(KS)$ into the bitstream $S_{KS}(BS)$ and keystream $E^G(KS)$ and then again encrypts the split keystream $E^G(KS)$ by encryption algorithm $E^{SC}_{Ak(\cdot)}$ to then output the same to smart card 3. The split bitstream $S_{KS}(BS)$ is output to ATV decoder 2 with the extracted portion of the keystream $E^G(KS)$ inserted with an index code IDX.

[0123] At this time, smart card 3 having received the index code IDX through ATV decoder 2, decrypts the encrypted keystream $E^{SC}_{Ak}[E^G(KS)]$ of copy protection processor 2 by decryption algorithm $D^{SC}_{Ak(\cdot)}$ for smart card and outputs the key stream (descrambling information) KS to ATV decoder 2 (S117).

[0124] Accordingly, ATV decoder 2 reads the key stream KS of smart card 3, determines a descrambling method and decrypts the bitstream $S_{KS}(BS)$ input through copy protection processor 4, thereby outputting analog video and audio signals.

[0125] Also, in the case of recording the data recorded as shown in FIG. 14 onto a different VCR, the PPC function is performed as shown in FIG. 16. If the bitstream $S_{KS}(BS)+E^G(KS)$ played back from VCR 5 is input to copy protection processor 4, copy protection processor 4 splits the bitstream $S_{KS}(BS)+E^G(KS)$ into the bitstream $S_{KS}(BS)$ and keystream $E^G(KS)$ and then again encrypts the split keystream $E^G(KS)$ by encryption algorithm $E^{SC}_{Ak(\cdot)}$ to then output the same to smart card 3. The split bitstream $S_{KS}(BS)$ is output to copy protection processor 8 of recording side with the extracted portion of the keystream $E^G(KS)$ inserted with the index code IDX.

[0126] At this time, smart card 3 of playback side decrypts the keystream $E^{SC}_{Ak}[E^G(KS)]$ encrypted in copy protection processor 4 by decryption algorithm $D^{SC}_{AI(\cdot)}$ with respect to the key information AI stored in RAM 15 and then outputs the decrypted keystream $D^{SC}_{AI}[E^G(KS)]$ to smart card 7 of recording side.

[0127] Accordingly, if smart card 7 of recording side receives the keystream $D^{SC}_{AI}[E^G(KS)]$ of smart card 3 of playback side and outputs the same to copy protection processor 8, copy protection processor 8 encrypts the keystream $D^{SC}_{AI}[E^G(KS)]$ and restores the same into the original encrypted keystream $E^G(KS)$, which is mixed with the bitstream $G_{KS}(BS)$ output from copy protection processor 4 of playback side according to the index code IDX to then be output to VCR 9, thereby recording the same onto another tape.

[0128] The data of the tape recorded in the above-described operations adopts the PPP function and is played back as shown in FIG. 15.

[0129] Also, in the case of recording the data recorded as shown in FIG. 14 onto another VCR, the back-up copy function is performed as shown in FIG. 17.

[0130] In other words, if the bitstream $S_{KS}(BS)+E^G(KS)$ played back from VCR 5 is input to copy protection processor 4, copy protection processor 4 splits the bitstream $S_{KS}(BS)+E^G(KS)$ into the bitstream $S_{KS}(BS)$ and keystream $E^G(KS)$ and then again encrypts the split keystream $E^G(KS)$ by encryption algorithm $E^{SC}_{Ak(\cdot)}$ to then output the same to smart card 3. The split bitstream $S_{KS}(BS)$ is output to copy protection processor 8 of recording side with the extracted portion of the keystream $E^G(KS)$ inserted with the index code IDX.

[0131] At this time, smart card 3 of playback side decrypts twice the keystream $E^{SC}_{Ak}[E^G(KS)]$ encrypted in copy protection processor 4 by decryption algorithm $D^{SC}_{AI(\cdot)}$ with respect to its own key information Ak stored in ROM 14 and then decrypts again by decryption algorithm $D^{SC}_{AI(\cdot)}$ with respect to the key information AI stored in RAM 15 and then outputs the decrypted keystream $D^{SC}_{AI}\{D^{SC}_{Ak}[E^G(KS)]\}$ to smart card 7 of recording side.

[0132] Accordingly, if the keystream $D^{SC}_{AI}\{D^{SC}_{Ak}[E^G(KS)]\}$ of smart card 3 of playback side is output to copy protection processor 8 of recording side through smart card 7 of recording side, copy protection processor 8 encrypts the keystream $D^{SC}_{AI}\{D^{SC}_{Ak}[E^G(KS)]\}$ with respect to the key information AI and restores the same into the original encrypted keystream $D^{SC}_{Ak}[E^G(KS)]$. The restored $D^{SC}_{Ak}[E^G(KS)]$ is mixed with the bitstream $G_{KS}(BS)$ output from copy protection processor 4 of playback side according to the index code IDX to then be output to VCR 9, thereby recording the same onto another tape.

[0133] Here, the charge is counted in the improved smart card 3 or 7.

[0134] The data recorded by performing the back-up copy function can be played back only from the VCR recording the original tape. In the case of a normal playback, the operation is executed as shown in FIG. 18A.

[0135] In other words, if the bitstream $S_{KS}(BS)+D^{SC}_{Ak}$

[E^G(KS)] played back from VCR 5 is input to copy protection processor 4, copy protection processor 4 splits the bitstream S_{KS}(BS)+D^{SC}_{Ak}[E^G(KS)] into the bitstream S_{KS}(BS) and keystream D^{SC}_{Ak}[E^G(KS)] and then again encrypts twice the split keystream D^{SC}_{Ak}[E^G(KS)] by encryption algorithm $E^{SC}_{Ak(\cdot)}$ to then output the same to smart card 3. The split bitstream S_{KS}(BS) is output to ATV decoder 2 with the extracted portion of the keystream D^{SC}_{Ak}[E^G(KS)] inserted with the index code IDX.

[0136] At this time, smart card 3 having received the index code IDX through ATV decoder 2 decrypts twice the keystream E^{SC}_{Ak}[E^G(KS)] encrypted in copy protection processor 2 by decryption algorithm $D^{SC}_{Ak}(\cdot)$ for smart card and then outputs the key stream (descrambling information) KS to ATV decoder 2.

[0137] Accordingly, ATV decoder 2 reads the key stream KS of smart card 3, determines a descrambling method and decrypts the bitstream S_{KS}(BS) input through copy protection processor 4, thereby outputting analog video and audio signals.

[0138] Also, in the case of an abnormal playback to another VCR not to the original recorded VCR, the operation is executed as shown in FIG. 18B, thereby disabling the playback of the tape.

[0139] In other words, if the copied tape is played back from VCR to which the tape copy has been performed, copy protection processor 8 splits the played-back data S_{KS}(BS)+D^{SC}_{Ak}[E^G(KS)] to separate the bitstream S_{KS}(BS)+IDX.

[0140] At this time, the split bitstream D^{SC}_{Ak}[E^G(KS)] is encrypted with respect to its own key information AI and is again encrypted with respect to the key information AI to become E^{SC}_{AI}{E^{SC}_{AI}(D^{SC}_{Ak}[E^G(KS)])} to then be transported to smart card 7.

[0141] At this time, smart card 7 cannot decrypt the keystream E^{SC}_{AI}{E^{SC}_{AI}(D^{SC}_{Ak}[E^G(KS)])}, so that the key information KS may not be transported to ATV decoder 6.

[0142] Accordingly, smart card 7 cannot descrambles the bitstream S_{KS}(BS) so that the copied tape cannot be played back.

[0143] As described above, since the authentication and key exchange process are automatically performed during power-on or connection between DVCRs, the illegal view and copy protection function for illegal smart card can be automatically performed. Also, since the illegal view and copy protection is partially performed, the scrambling process is performed with respect to a protection-desired portion of a program, thereby performing the illegal view and copy protection automatically and levying the charge in a desirable manner.

[0144] Also, in the described embodiment, since the split bitstream and keystream are transported to different paths, the protection data amount can be reduced, thereby efficiently performing the illegal view and copy protection. In implementing the illegal view protection and illegal copy protection for a smart card, the PPV, PPP, PPC and back-up copy functions are differentiated, thereby levying the charges differentially for the respective functions.

[0145] According to the described embodiment, the copy protection for digital signals, which is adoptable for DSM applications can be implemented, which allows a program copyright protection for a DSM such as a DVCR. Therefore, the reliability for illegal view and copy protection is increased.

[0146] Finally, in order to facilitate the understanding of the present invention, terms used in the specification will be defined as follows:

1) BS: non-scrambled GA bitstream;
2) KS=[K_0, K_1, K_2,... K_i,...K_n]: keystream (Here, n is total number of keys used for scrambling.);
3) BS=[BS_0, BS_1, BS_2,... BS_i, ...BS_n]: bitstream (Here, BS_i is one segment of BS and is a scrambling unit.);
4) S_{KS}(BS)=[S_{K0}(BS_0), S_{K1}(BS_1), S_{K2}(BS_2),... S_{KI}(BS_I),...S_{Kn}(BS_n)]: scrambled GA bitstream;
5) E(·)&D(·): algorithms used for encryption and decryption of keys in GA; E^G(KS)=[E^G(K_0), E^G(K_1), E^G(K_2),... E^G(K_i),...E^G(K_n)] and D^G[E^G(KS)]=[D^G[E^G(K_0)], D^G[E^G(K_1)], D^G[E^G(K_2)],... D^G[E^G(K_i)],...D^G[E^G(K_n)]]=KS;
6) IDX=[0, 1, 2,... i,... n]: index stream;
7) Ak: authentication key for smart card (k); and
8) $E^{SC}_{A(\cdot)}$&$D^{SC}_{A(\cdot)}$: encryption and decryption algorithms for smart card used the smart card authentication key (A) as the key.

Claims

1. An illegal view and copy protection method in a digital video system comprising:

   a determination step for determining whether received data has been scrambled;
   a reproduction step, if the received data was determined to be scrambled data in the determination step, splitting the scrambled data into a bitstream and a keystream for decrypting the split keystream for reading in key information, and descrambling the split bitstream according to the read in key information for displaying the bitstream on a display;
   a recording step for, if the received data was determined to be scrambled data in the determination step, recording the scrambled data on a recording medium either as scrambled data of a bitstream and a keystream according to a recording or copying mode, or after splitting the scrambled data into a bitstream and a keystream, encrypting the split keystream, and mixing the encrypted keystream with the bitstream; and,

a transporting step, if the received data was determined to be scrambled data in the determination step, splitting the scrambled data into a bitstream and a keystream for transporting the split keystream either after decrypting the split keystream with respect to key information from recording side according to a pay-per-copy (PPC) mode or a back-up copy mode, or after decrypting the split keystream two times with respect to key information contained therein and key information from recording side;
thereby the reproduction step, the recording step and the transporting step can be performed simultaneously or selectively.

2. An illegal view and copy protection method in a digital video system as claimed in claim 1, wherein, if the received data was determined to be unscrambled data in the determination step, said illegal view and copy protection method is not applied to the unscrambled data.

3. An illegal view and copy protection method in a digital video system as claimed in claim 1, wherein the reproduction step includes the step of decrypting said split keystream with a decryption algorithm, for reading in key information.

4. An illegal view and copy protection method in a digital video system as claimed in claim 1,
wherein a copying operation in the recording step includes,

a first step for encrypting the key stream with respect to its own key information,
a second step for determining the encrypted keystream of being a back-up copy mode or a PPC mode,
a third step for, if the mode was determined to be the PPC mode in the second step encrypting the keystream transported after being decrypted with respect to the key information from a recording side, and then inserting the same into a position corresponding to an index code to record the same together with the bitstream, and
a fourth step for, if the mode is determined to be the back-up copy mode in the second step, encrypting the keystream transported after being decrypted with respect to its own key information and the key information from a recording side

decrypting the same with respect to its own key information, and then inserting the same into a position corresponding to an index code, to record the same together with the bitstream.

5. An illegal view and copy protection method in a digital video system as claimed in claim 4,
wherein said PPC mode operation the third step includes,

a first transportation step for transporting the scrambled data after splitting the bitstream and the keystream and inserting said index code into the split portion of said keystream,
a second transportation step for transporting the keystream split in the first transportation step after encrypting the keystream with respect to its own key information and decrypting the same with respect to the key information from a recording side,
a recording step for recording the keystream transported in the second transportation step on a recording medium after encrypting the keystream with respect to the key information from a recording side in correspondence with the index code and mixing the same with the bitstream transported in the first transportation step.

6. An illegal view and copy protection method in a digital video system as claimed in claim 5,
wherein the reproduction operation after finish of the recording step includes,

a splitting step for splitting the reproduced bitstream into a bitstream and a keystream and inserting an index code into the split portion of the keystream,
an encrypting step for encrypting the keystream split in the splitting step with respect to its own key information,
a reading in step for reading in key information by decrypting the keystream encrypted in the encrypting step, with respect to its own key information, and
a decrypting step for descrambling the bitstream split according to the key information read in in the reading in step.

7. An illegal view and copy protection method in a digital video system as claimed in claim 4,
wherein said back-up copy mode operation in the fourth step includes,

a first transportation step for transporting the scrambled data after splitting the scrambled data into a bitstream and a keystream and inserting an index code into the split portion of the keystream,
a second transportation step for transporting the keystream split in the first transportation step after encrypting the keystream with respect to its own key information and decrypting

the encrypted keystream with respect to the key information from a recording side and its own key information,
a recording step for recording the keystream transported in the second transportation step on a recording medium after encrypting the keystream with respect to the key information from a recording side in correspondence with the index code and mixing the same with the bitstream transported in the first transportation step.

8. An illegal view and copy protection method in a digital video system as claimed in claim 7, wherein the reproduction operation after finish of the recording step includes,

a splitting step for splitting the reproduced bitstream into a bitstream and a keystream and inserting an index code into the split portion of the keystream,
an encrypting step for encrypting the keystream split in the splitting step with respect to its own key information,
a reading in step for reading in key information by decrypting the keystream encrypted for two times in the encrypting step, with respect to its own key information and the MPEG bitstream, and
a decrypting step for descrambling the bitstream split according to the key information read in in the reading in step.

9. An illegal view and copy protection method in a digital video system as claimed in claim 1, wherein the transporting step comprises:

a mode determining step for determining the mode of the keystream being a back-up copy mode or a PPC mode;
a first keystream transportation step for, if the mode was determined to be a PPC mode in the mode determining step, decrypting the keystream with respect to key information from a recording side for transporting the keystream;
a first transporting recording step for encrypting the keystream transported in the first keystream transportation step with respect. to the key information from the recording side and inserting the encrypted keystream into a position designated by an index code, for recording the keystream together with a bitstream on a recording medium;
a second keystream transportation step for, if the mode was determined to be a back-up copy mode in the determining step, decrypting the keystream for two times with respect to its own key information and the key information from the recording side for transporting the keystream; and
a second transporting recording step for encrypting the keystream transported in the second keystream transportation step with respect to the key information from the recording side and inserting the encrypted keystream into the position corresponding to the index code, for recording the keystream together with the bitstream on a recording medium.

10. An illegal view and copy protection method in a digital video system as claimed in claim 9, wherein the first keystream transportation step includes the steps for decrypting the keystream, encrypted with respect to its own key information, with respect to its own key information and decrypting the keystream again with respect to the key information from the recording side, for transporting the keystream.

11. An illegal view and copy protection method in a digital video system as claimed in claim 9, wherein the second keystream transportation step includes the step for decrypting the bitstream, decrypted with respect to its own key information, for two times with respect to its own key information and decrypting the keystream again with respect to the key information from the recording side for transporting the keystream.

12. An illegal view and copy protection method in à digitalvideo system as claimed in claim 1, wherein the reproduction step further comprises:

a 'PPC' mode reproduction step for, having determined the recording medium being a 'PPC' recording medium on detection of a keystream at reproduction from a recording medium, encrypting the keystream with respect to its own key information and decrypting the keystream with respect to its own key information for reading in the key information, for descrambling the bitstream using both the read in key information and an index code; and,
a 'back-up copy' mode reproduction step for, having determined the recording medium being a 'back-up copy' recording medium on detection of a keystream decrypted with respect to its own key information at reproduction from a recording medium, encrypting the keystream for two times with respect to its own key information and the key information from a recording side and decrypting the keystream with respect to its own key information for reading in the key information, for descrambling the bitstream using both the read in key information and an index code.

13. A digital video system including an illegal view and copy protection device, the device comprising means for carrying out the method steps of any of claims 1 to 12.

Patentansprüche

1. Verfahren zum Schutz vor unerlaubtem Sehen und Kopieren in einem digitalen Videosystem, umfassend:

einen Bestimmungsschritt zum Bestimmen, ob empfangene Daten verwürfelt wurden;

einen Wiederherstellungsschritt, der, wenn in dem Bestimmungsschritt bestimmt wurde, daß die empfangenen Daten verwürfelt sind, die verwürfelten Daten in einen Bitstrom und einen Schlüsselstrom aufteilt, um den abgeteilten Schlüsselstrom zu entschlüsseln und um dann Schlüsselinformation einzulesen, und um den abgeteilten Bitstrom entsprechend der eingelesenen Schlüsselinformation zu entwürfeln, um den Bitstrom auf einer Sichtanzeige darzustellen;

einen Aufnahmeschritt, um, wenn in dem Bestimmungsschritt bestimmt wurde, daß die empfangenen Daten verwürfelte Daten sind, die verwürfelten Daten auf einem Aufnahmemedium aufzunehmen, und zwar entweder als verwürfelte Daten eines Bitstroms und eines Schlüsselstroms entsprechend einer Aufnahme- oder Kopierbetriebsart, oder, nach Aufteilung der verwürfelten Daten in einen Bitstrom und einen Schlüsselstrom, zum Verschlüsseln des abgeteilten Schlüsselstroms und Mischen des verschlüsselten Schlüsselstroms mit dem Bitstrom; und

einen Beförderungsschritt, der, wenn im Bestimmungsschritt bestimmt wurde, daß die empfangenen Daten verwürfelte Daten sind, die verwürfelten Daten zum Befördern des abgeteilten Schlüsselstroms in einen Bitstrom und einen Schlüsselstrom aufteilt, und zwar entweder nach dem Entschlüsseln des abgeteilten Schlüsselstroms in bezug auf die Schlüsselinformation von der Aufnahmeseite her entsprechend einer Bezahl-pro-Kopie (pay-per-copy, PPC) -Betriebsart oder entsprechend einer Sicherungskopie-Betriebsart, oder nach dem zweimaligen Entschlüsseln des abgeteilten Schlüsselstroms in bezug auf die darin enthaltene Schlüsselinformation und die Schlüsselinformation von der Aufnahmeseite her;

dabei können der Wiederherstellungsschritt, der Aufnahmeschritt und der Beförderungsschritt gleichzeitig oder wahlweise ausgeführt werden.

2. Verfahren zum Schutz vor unerlaubtem Sehen und Kopieren in einem digitalen Videosystem nach Anspruch 1, worin, wenn im Bestimmungaschritt bestimmt wurde, daß die empfangenen Daten unverwürfelte Daten sind, das Verfahren zum Schutz vor unerlaubtem Kopieren und Sehen nicht auf die unverwürfelten Daten angewendet wird.

3. Verfahren zum Schutz vor unerlaubtem Sehen und Kopieren in einem digitalen Videosystem nach Anspruch 1, worin der Wiederherstellungsschritt den Schritt zum Entschlüsseln des abgeteilten Schlüsselstroms mit einem Entschlüsselungsalgorithmusses zum Einlesen von Schlüsselinformation umfasst.

4. Verfahren zum Schutz vor unerlaubtem Sehen und Kopieren in einem digitalen Videosystem nach Anspruch 1, worin ein Kopiervorgang in dem Aufnahmeschritt folgende Schritte beinhaltet:

einen ersten Schritt zum verschlüsseln des Schlüsselstroms in bezug auf seine eigene Schlüsselinformation,

einen zweiten Schritt zum Bestimmen, ob der des verschlüsselte Schlüsselstrom in einer Sicherungskopie-Betriebsart oder einer PPC-Betriebsart vorliegt,

einen dritten Schritt, um, wenn im zweiten Schritt bestimmt wurde, daß die Betriebsart eine PPC Betriebsart ist, den Schlüsselstrom zu verschlüsseln, welcher nach Entschlüsselung in bezug auf die Schlüsselinformation von einer Aufnahmeseite her befördert wurde, und um dann denselben in eine Position einzufügen, die einer Indexkennung entspricht, um denselben zusammen mit dem Bitstrom aufzunehmen, und

einen vierten Schritt, um, wenn im zweiten Schritt bestimmt wurde, daß die Betriebsart eine Sicherungskopie-Betriebsart ist, den nach seiner Entschlüsselung transportierten Schlüsselstrom in bezug auf seine eigene Schlüsselinformation und die Schlüsselinformation von einer Aufnahmeseite her zu verschlüsseln, und um denselben in eine Position entsprechend einer Indexkennung einzufügen, um denselben zusammen mit dem Bitstrom aufzunehmen.

5. Verfahren zum Schutz vor unerlaubtem Sehen und

Kopieren in einem digitalen Videosystem nach Anspruch 4, worin die PPC-Betriebsart des dritten Schrittes folgendes beinhaltet:

einen ersten Beförderungsschritt zum Befördern der verwürfelten Daten nach Aufteilung des Bitstroms und des Schlüsselstroms und Einfügen der Indexkennung in den abgeteilten Teil des Schlüsselstroms,

einen zweiten Beförderungsschritt zum Befördern des Schlüsselstroms, welcher im ersten Beförderungsschritt abgeteilt wurde, nachdem der Schlüsselstrom in bezug auf seine eigene Schlüsselinformation verschlüsselt wurde und derselbe in bezug auf die Schlüsselinformation von einer Aufnahmeseite her entschlüsselt wurde,

einen Aufnahmeschritt zur Aufnahme des Schlüsselstroms, welcher im zweiten Beförderungsschritt nach Verschlüsselung des Schlüsselstroms in bezug auf die Schlüsselinformation von einer Aufnahmeseite her in Zuordnung mit der Indexkennung auf einen Aufzeichnungsträger befördert wurde, und zum Mischen desselben mit dem im ersten Beförderungsschritt beförderten Bitstrom.

6. Verfahren zum Schutz vor unerlaubtem Sehen und Kopieren in einem digitalen Videosystem nach Anspruch 5, worin der Wiedergabebetrieb nach Abschluss des Aufnahmeschrittes folgendes beinhaltet:

einen Aufteilungsschritt zur Aufteilung des wiedergegebenen Bitstroms in einen Bitstrom und einen Schlüsselstrom und Einfügen einer Indexkennung in den abgeteilten Teil des Schlüsselstroms,

einen verschlüsselungsschritt zum Verschlüsseln des Schlüsselstroms, welcher im Aufteilungsschritt in bezug auf seine eigene Schlüsselinformation abgeteilt wurde,

ein Einleseschritt zum Einlesen der Schlüsselinformation durch Entschlüsseln des Schlüsselstroms, welcher im Verschlüsselungsschritt in bezug auf seine eigene Schlüsselinformation verschlüsselt wurde, und

einen Entschlüsselungsschritt zum Entwürfeln des Bitstroms, welcher gemäß der im Einleseschritt eingelesenen Schlüsselinformation abgeteilt wurde.

7. Verfahren zum Schutz vor unerlaubtem Sehen und Kopieren in einem digitalen Videosystem nach Anspruch 4, worin die Sicherungskopie-Betriebsart im vierten Schritt folgende Schritte beinhaltet:

einen ersten Beförderungsschritt zum Befördern der verwürfelten Daten nach Aufteilung der verwürfelten Daten in einen Bitstrom und einen Schlüsselstrom und Einfügen einer Indexkennung in den abgeteilten Teil des Schlüsselstroms,

einen zweiten Beforderungsschritt zum Befördern des Schlüsselstroms, welcher im ersten Beförderungsschritt abgeteilt wurde nach Verschlüsselung des Schlüsselstromes in bezug auf seine eigene Schlüsselinformation und zum Entschlüsseln des verschlüsselten Schlüsselstromes in bezug auf die Schlüsselinformation von einer Aufnahmeseite und seiner eigenen Schlüsselinformation her,

einen Aufnahmeschritt zum Aufnehmen des Schlüsselstromes, welcher im zweiten Beförderungsschritt befördert wurde auf ein Aufnahmemedium nach Verschlüsselung des Schlüsselstromes in bezug auf die Schlüsselinformation von einer Aufnahmeseite her in Zuordnung mit der Indexkennung und nach Mischen desselben mit dem Bitstrom, welcher im ersten Beförderungsschritt befördert wurde.

8. Verfahren zum Schutz vor unerlaubtem Sehen und Kopieren in einem digitalen Videosystem nach Anspruch 7, worin der Wiedergabebetrieb nach Beenden des Aufnahmeschrittes folgende Schritte beinhaltet:

einen Aufteilungsschritt zur Aufteilung des wiedergegebenen Bitstromes in einen Bitstrom und einen Schlüsselstrom und zum Einfügen einer Indexkennung in den abgeteilten Teil des Schlüsselstromes,

einen Verschlüsselungsschritt zum Verschlüsseln des Schlüsselstromes, welcher im Aufteilungsschritt in bezug auf seine eigene Schlüsselinformation abgeteilt wurde,

einen Einleseschritt zum Einlesen von Schlüsselinformation durch Entschlüsseln des Schlüsselstromes, welcher zweimalig im Verschlüsselungsschritt in bezug auf seine eigene Schlüsselinformation und den MPEG Bitstrom verschlüsselt wurde, und

einen Entschlüsselungsschritt zum Entschlüsseln des Bitstromes, welcher entsprechend der im Einleseschritt eingelesenen Schlüsselinfor-

mation abgeteilt wurde.

9. Verfahren zum Schutz vor unerlaubtem Sehen und Kopieren in einem digitalen Videosystem nach Anspruch 1, worin der Beförderungsschritt umfasst:

einen Betriebsart-bestimmenden Schritt zum Bestimmen der Betriebsart des Schlüsselstromes, welche eine Sicherungskopie-Betriebsart oder eine PPC Betriebsart ist;

einen ersten Schlüsselstrom-Beförderungsschritt, um, wenn im Betriebsart-bestimmenden Schritt bestimmt wurde, daß die Betriebsart eine PPC-Betriebsart ist, den Schlüsselstrom in bezug auf die Schlüsselinformation von einer Aufnahmeseite her zum Befördern des Schlüsselstromes zu entschlüsseln;

einen ersten Beförderungsaufnahmeschritt, um den schlüsselstrom, welcher im ersten Schlüsselstrom-Beförderungsschritt in bezug auf die Schlüsselinformation von der Aufnahmeseite her befördert wurde zu verschlüsseln, und um den verschlüsselten Schlüsselstrom in eine Position einzufügen, welche durch eine Indexkennung bestimmt ist, und um den Schlüsselstrom zusammen mit einem Bitstrom auf ein Aufnahmemedium aufzunehmen;

einen zweiten Schlüsselstrom-Beförderungsschritt, um, wenn im Bestimmungsschritt bestimmt wurde, daß die Betriebsart eine Sicherungskopie-Betriebsart ist, den Schlüsselstrom zweimalig in bezug auf seine eigene Schlüsselinformation und die Schlüsselinformation von der Aufnahmeseite her zum Befördern des Schlüsselstromes zu entschlüsseln; und

einen zweiten Beförderungs-Aufnahme-Schritt, um den Schlüsselstrom, welcher im zweiten Schlüsselstrom-Beförderungsschritt in bezug auf die Schlüsselinformation von der Aufnahmeseite her befördert wurde, zu verschlüsseln, und um den verschlüsselten Schlüsselstrom in die Position entsprechend der Indexkennung einzufügen, und um den Schlüeselstrom zusammen mit dem Bitstrom auf ein Aufnahmemedium aufzunehmen.

10. Verfahren zum Schutz vor unerlaubtem Sehen und Kopieren in einem digitalen Videosystem nach Anspruch 9, worin der erste Schlüsselstrom-Beförderungsschritt die Schritte zur Entschlüsselung des Schlüsselstromes in bezug auf seine eigene Schlüsselinformation beinhaltet, welcher in bezug auf seine eigene Schlüsselinformation verschlüsselt wurde, und um den Schlüsselstrom wieder in bezug auf die Schlüsselinformation von der Aufnahmeseite her zu entschlüsseln, und um den Schlüsselstrom zu befördern.

11. Verfahren zum Schutz vor unerlaubtem Sehen und Kopieren in einem digitalen Videosystem nach Anspruch 9, worin der zweite Schlüsselstrom-Beförderungsschritt den Schritt zur zweimaligen Entschlüsselung des Bitstromes in bezug auf seine eigene Schlüsselinformation beinhaltet, welcher in bezug auf seine eigene Schlüsselinformation entschlüsselt wurde, und um den Schlüsselstrom wieder in bezug auf die Schlüsselinformation von der Aufnahmeseite her zum Befördern des Schlüsselstromes zu entschlüsseln.

12. Verfahren zum Schutz vor unerlaubtem Sehen und Kopieren in einem digitalen Videosystem nach Anspruch 1, worin der Wiedergabeschritt ferner umfasst:

einen 'PPC'-Betriebsart-Wiedergabeschritt, um, wenn bei Nachweis eines Schlüsselstromes bei Wiedergabe von einem Aufnahmemedium bestimmt wurde, daß das Aufnahmemedium ein 'PPC'-Aufnahmemedium ist, den Schlüsselstrom in bezug auf seine eigene Schlüsselinformation zu verschlüsseln, und um den Schlüsselstrom in bezug auf seine eigene Schlüsselinformation zum Einlesen der Schlüsselinformation zu entschlüsseln, und um den Bitstrom unter Verwendung sowohl der eingelesenen Schlüsselinformation und einer Indexkennung zu entwürfeln; und

einen 'Sicherungskopie'-Betriebsart-Wiedergabeschritt, um, wenn bei Nachweis eines Schlüsselstromes bei Wiedergabe von einem Aufnahmemedium bestimmt wurde, daß das Aufnahmemedium ein 'Sicherungskopie'- Aufnahmemedium ist, den Schlüsselstrom zweimalig in bezug auf seine eigene Schlüsselinformation und der Schlüsselinformation von einer Aufnahmeseite her zu verschlüsseln, und um den Schlüsselstrom in bezug auf seine eigene Schlüsselinformation zum Einlesen der Schlüsselinformation zu entschlüsseln, und um den Bitstrom unter Verwendung sowohl der Einleseschlüsselinformation und einer Indexkennung zu entwürfeln.

13. Digitales Videosystem mit einem Gerät zum Schutz vor unerlaubtem Sehen und Xopieren, wobei das Gerät Mittel zur Ausführung der Verfahrensschritte nach den Ansprüchen 1 bis 12 umfasst.

Revendications

1. Un procédé de protection contre le visionnage et la copie illégaux dans un système de vidéo numérique comprenant :

   - une étape consistant à déterminer si des données reçues sont brouillées ou pas;
   - dans le cas où il a élé déterminé dans l'étape de détermination que les données reçues sont des données brouillées, une étape de reproduction consistant à séparer les données brouillées en un flux de bits et un flux de clés de cryptage pour le décryptage du flux de clés de cryptage ainsi séparé pour la lecture des informations sur la clé, et pour décrypter le flux de bits ainsi séparé au moyen des informations de clé lues pour l'affichage du flux de bits sur un organe d'affichage ;
   - dans le cas où il a été déterminé à l'étape de détermination que les données reçues sont des données brouillées, une étape d'enregistrement des données brouillées sur un support d'enregistrement soit sous forme de données brouillées composées d'un flux de bits et d'un flux de clés de cryptage correspondant à un mode d'enregistrement ou un mode de copie, ou, après avoir séparé les données brouillées en un flux de bits et un flux de clés de cryptage, à effectuer le cryptage du flux de clés de cryptage ainsi séparé, avec mélange du flux de clés de cryptage ainsi crypté avec le flux de bits ; et
   - dans le cas où il a été déterminé lors de l'étape de détermination que les données reçues sont des données brouillées, une étape de transport consistant à diviser les données brouillées en un flux de bits et un flux de clés de cryptage pour le transport du flux de clés de cryptage ainsi séparé après avoir, soit décrypté le flux de clés ainsi séparé en utilisant des informations de clé obtenues du côté de l'enregistrement en mode paiement par copie (PPC) ou un mode de copie de sauvegarde, soit après avoir décrypté deux fois le flux de clés séparé en utilisant des informations de clé qui y sont contenues ainsi que des informations de clé venant du côté de l'enregistrement;

   de sorte que l'étape de reproduction, l'étape d'enregistrement et l'étape de transport puissent être effectuées simultanément ou sélectivement.

2. Un procédé de protection contre le visionnage et la copie illégaux dans un système de vidéo numérique selon la revendication 1, dans lequel, dans le cas où il a été déterminé au niveau de l'étape de détermination que les données reçues sont des données non brouillées, ledit procédé de protection contre le visionnage et la copie illégaux n'est pas appliqué aux données non brouillées.

3. Un procédé de protection contre le visionnage et la copie illégaux dans un système de vidéo numérique selon la revendication 1, dans lequel l'étape de reproduction comprend l'étape consistant à décrypter le flux de clés de cryptage ainsi séparé au moyen d'un algorithme de décryptage, pour la lecture des informations de clé.

4. Un procédé de protection contre le visionnage et la copie illégaux dans un système de vidéo numérique selon la revendication 1, dans lequel une opération de copie lors de l'étape d'enregistrement comprend :

   - une première étape pour crypter le flux de clés au moyen de sa propre information de clé ;
   - une deuxième étape consistant à déterminer si, en ce qui concerne le flux de clés de cryptage, il s'agit d'un mode de copie de sauvegarde ou d'un mode de paiement à la copie (PPC) ;
   - une troisième étape permettant si, lors de la deuxième étape il a été déterminé qu'il s'agit d'un mode de paiement à la copie (PPC), de crypter le flux de clés de cryptage transporté après avoir été décrypté au moyen de sa propre information de clés venant du côté de l'enregistrement, suivie de l'insertion de ce flux dans une position correspondant à un code d'index afin d'enregistrement ce flux avec le flux de bits ; et
   - une quatrième étape permettant, dans le cas où il a été déterminé lors de la deuxième étape qu'il s'agit d'un mode de copie de sauvegarde, de crypter le flux de clés de cryptage transporté après décryptage au moyen de sa propre information de clés et l'information de clés du côté de l'enregistrement au moyen de l'information de clé du côté de l'enregistrement, et à décrypter ce flux au moyen de sa propre information de clé, et à insérer ensuite ce flux dans une position correspondant à un code d'index, afin d'enregistrer ce flux avec le flux de bits.

5. Un procède de protection contre le visionnage et la copie illégaux dans un système de vidéo numérique selon la revendication 4, dans lequel, dans le cas d'un mode de fonctionnement à paiement à la copie (PPC), la troisième étape comprend :

   - une première étape de transport pour transporter les données brouillées après séparation du flux de bits et du flux de clés de cryptage avec insertion dudit code d'index dans la partie séparée dudit flux de clés de cryptage ;
   - une deuxième étape de transport pour trans-

porter le flux de clés de cryptage séparé lors de la première étape de transport après le cryptage du flux de clés au moyen de sa propre information de clés, et en décryptant ce flux au moyen de l'information de clés venant du côté de l'enregistrement ;

- une étape d'enregistrement pour enregistrer le flux de clés transporté lors de la deuxième étape de transport sur un support d'enregistrement après cryptage du flux de clés en fonction de l'information de clés venant du côté de l'enregistrement en correspondance avec le code d'index avec mélange de ce flux avec le flux de bits transporté lors de la première étape de transport.

6. Un procédé de protection contre le visionnage et la copie illégaux dans un système de vidéo numérique selon la revendication 5, dans lequel l'opération de reproduction après la fin de l'étape d'enregistrement comprend :

- une étape de séparation pour séparer le flux de bits reproduit en un flux de bits et un flux de clés de cryptage avec insertion d'un code d'index dans la partie séparée du flux de clé de cryptage ;
- une étape de cryptage pour crypter le flux de clés de cryptage séparé lors de l'étape de séparation, au moyen de sa propre information de clés ;
- une étape de lecture de données pour la lecture de l'information de clés par décryptage du flux de clés de cryptage crypté lors de l'étape de cryptage par rapport à sa propre information de clés ; et
- une étape de décryptage pour désembrouiller le flux de bits séparé, au moyen de l'information de clés lue lors de l'étape de lecture de données.

7. Un procédé de protection contre le visionnage et la copie illégaux dans un système de vidéo numérique selon la revendication 4, dans lequel le fonctionnement dudit mode de copie de sauvegarde lors de la quatrième étape comprend :

- une première étape de transport pour le transport de données brouillées après avoir séparé les données brouillées en un flux de bits, et un flux de clés de cryptage avec insertion d'un code d'index dans la partie divisée du flux de clés de cryptage ;
- une deuxième étape de transport pour transporter le flux de clés de cryptage séparé lors de la première étape de transport après cryptage du flux de clés de cryptage au moyen de sa propre information de clés et pour décrypter le flux de clé de cryptage crypté au moyen de l'information de clés venant du côté de l'enregistrement et sa propre information de clés ;
- une étape d'enregistrement pour enregistrer le flux de clés de cryptage transporté lors de la deuxième étape de transport sur un support d'enregistrement après cryptage du flux de clés de cryptage au moyen de l'information de clés venant du côté de l'enregistrement, en correspondance à un code d'index, avec mélange de ce flux avec le flux de bits transporté lors de la première étape de transport.

8. Un procédé de protection contre le visionnage et la copie illégaux dans un système de vidéo numérique selon la revendication 7, dans lequel l'opération de reproduction après la fin de l'étape d'enregistrement comprend :

- une étape de séparation pour séparer le flux de bits restitué en un flux de bits et un flux de clés de cryptage avec insertion d'un code d'index dans la partie séparée du flux de clés de cryptage ;
- une étape de cryptage pour crypter le flux de clés de cryptage séparé lors de l'étape de séparation au moyen de sa propre information de clés ;
- une étape de lecture de données pour lire l'information de clés en décryptant le flux de clés de cryptage crypté deux fois lors de l'étape de cryptage, au moyen de sa propre information de clé et le flux de bits MPEG ; et
- une étape de décryptage pour désembrouiller le flux de bits séparé, au moyen de l'information de clé lue lors de l'étape de lecture de données.

9. Un procédé de protection contre le visionnage et la copie illégaux dans un système de vidéo numérique selon la revendication 1, dans lequel l'étape de transport comprend :

- une étape de détermination de mode pour déterminer si le flux de clés de cryptage est en mode de copie de sauvegarde ou d'un mode de paiement à la copie ;
- une première étape de transport de flux de clés de cryptage pour, dans le cas où il a été déterminé lors de l'étape de détermination qu'il s'agit d'un mode de paiement à la copie (PPC), décrypter le flux de clés de cryptage au moyen de l'information de clés venant du côté de l'enregistrement, pour le transport du flux de clés de cryptage ;
- une première étape d'enregistrement de transport pour crypter le flux de clés de cryptage transporté lors de la première étape de transport de flux de clés de cryptage au moyen de

l'information de clé provenant du côté de l'enregistrement avec insertion du flux de clés de cryptage crypté dans une position désignée par un code d'index, pour enregistrer le flux de clés de cryptage avec le flux de bits sur un support d'enregistrement ;

- une deuxième étape de transport de flux de clés de cryptage pour, lorsqu'il a été déterminé lors de l'étape de détermination qu'il s'agit d'un mode de copie de sauvegarde, décrypter le flux de clés de cryptage deux fois au moyen de sa propre information de clés ainsi que l'information de clés venant du côté de l'enregistrement pour transporter le flux de clés de cryptage ; et
- une deuxième étape d'enregistrement de transport pour crypter le flux de clés de cryptage transporté lors de la deuxième étape de transport de flux de clés de cryptage au moyen de l'information de clés venant du côté de l'enregistrement et pour insérer le flux de clés de cryptage crypté dans la position correspondant au code d'index, pour enregistrer le flux de clé de cryptage avec le flux de bits, sur un support d'enregistrement.

10. Un procédé de protection contre le visionnage et la copie illégaux dans un système de vidéo numérique selon la revendication 9, dans lequel la première étape de transport de flux de clés de cryptage comprend les étapes consistant à décrypter le flux de clés de cryptage, crypté au moyen de sa propre information de clés, moyennant sa propre information de clés et à décrypter encore une fois le flux de clés de cryptage au moyen de la clé d'information venant du côté de l'enregistrement, pour le transport du flux de clés de cryptage.

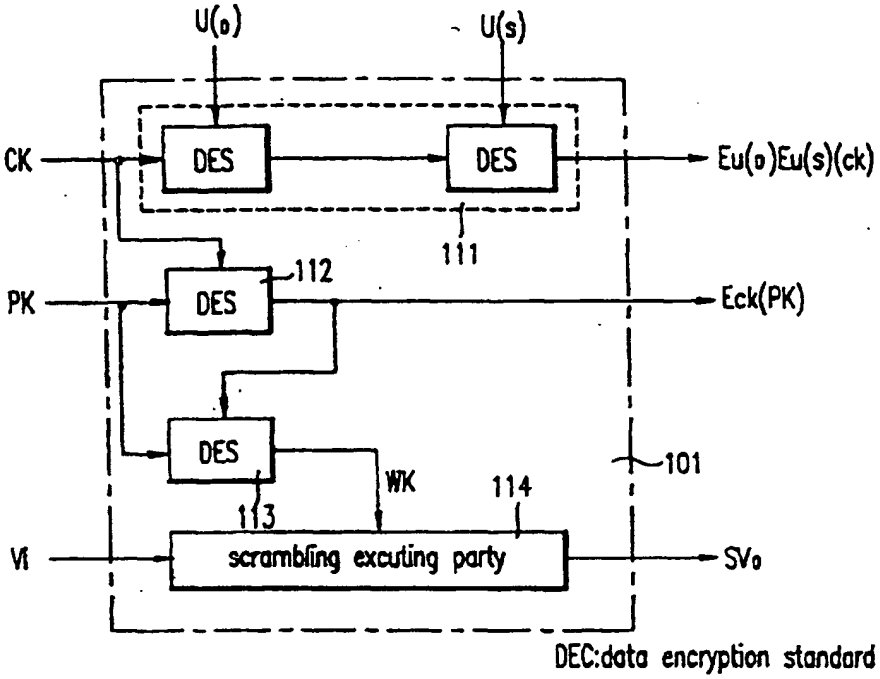
11. Un procédé de protection contre le visionnage et la copie illégaux dans un système de vidéo numérique selon la revendication 9, dans lequel la deuxième étape de transport de flux de clés de cryptage comprend l'étape consistant à décrypter le flux de clés de cryptage, décrypté au moyen de sa propre information de clés, deux fois, une première fois au moyen de sa propre information de clés et une deuxième fois au moyen de l'information de clés venant du côté de l'enregistrement, pour le transport du flux de clés de cryptage.

12. Un procédé de protection contre le visionnage et la copie illégaux dans un système de vidéo numérique selon la revendication 1, dans lequel l'étape de restitution comprend en outre :

- une étape de restitution du mode "paiement à la copie" (PPC) pour, après avoir déterminé qu'il s'agit d'un support d'enregistrement en mode "paiement à la copie" suite à la détection d'un flux de clés de cryptage lors de la lecture du support d'enregistrement, crypter le flux de clés de cryptage au moyen de sa propre information de clés et à décrypter le flux de clés de cryptage au moyen de sa propre information de clés pour la lecture de l'information de clés, pour le désembrouillage du flux de bits en utilisant l'information de clés ainsi lue et un code d'index ; et
- une étape de restitution en mode "copie de sauvegarde", après avoir déterminé qu'il s'agit d'un support d'enregistrement pur un mode "copie de sauvegarde", suite à la détection d'un flux de clés de cryptage décrypté au moyen de sa propre information de clés lors de la lecture à partir d'un support d'enregistrement, pour crypter le flux de clés de cryptage deux fois au moyen de sa propre information de clés, et l'information de clés venant du côté de l'enregistrement et pour décrypter le flux de clés de cryptage au moyen de sa propre information de clés pour la lecture de l'information de clés, pour désembrouiller le flux de bits en utilisant l'information de clés ainsi lue et un code d'index.

13. Un système de vidéo numérique comprenant un dispositif de protection contre le visionnage et la copie illégaux, le dispositif comprenant des moyens pour mettre en oeuvre les étapes du procédé selon l'une quelconque des revendications 1 à 12.

F.I G.1
prior art



DEC:data encryption standard

F.I G.2
prior art

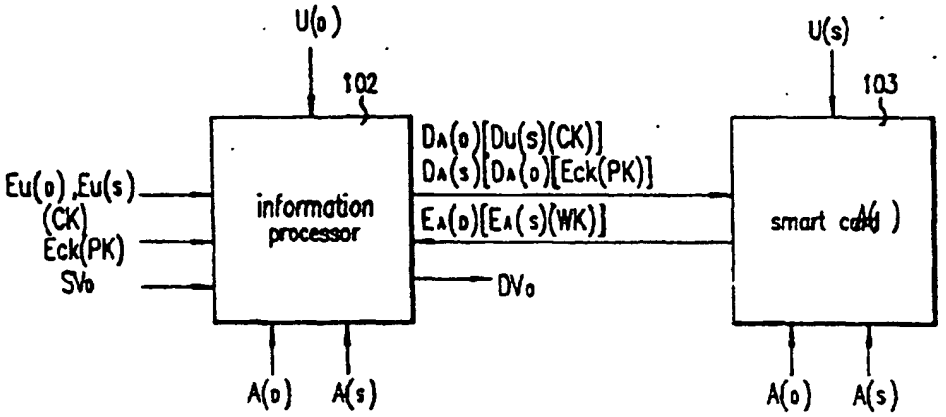
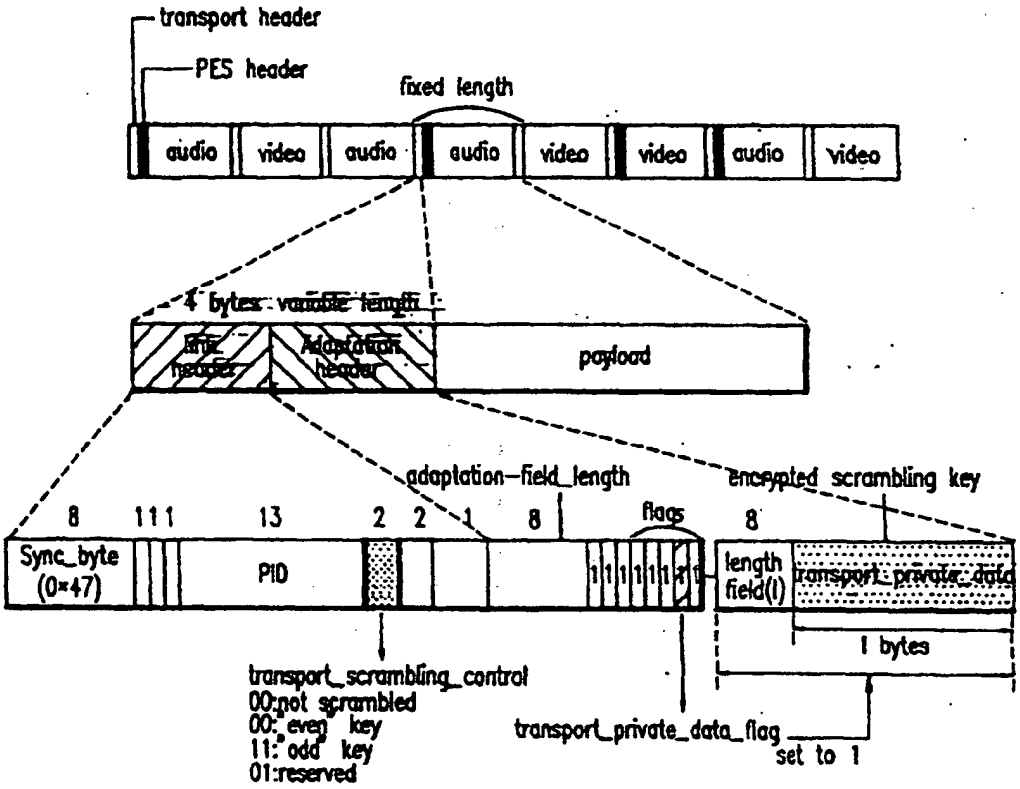


FIG.3
prior art



F.I G.4
prior art

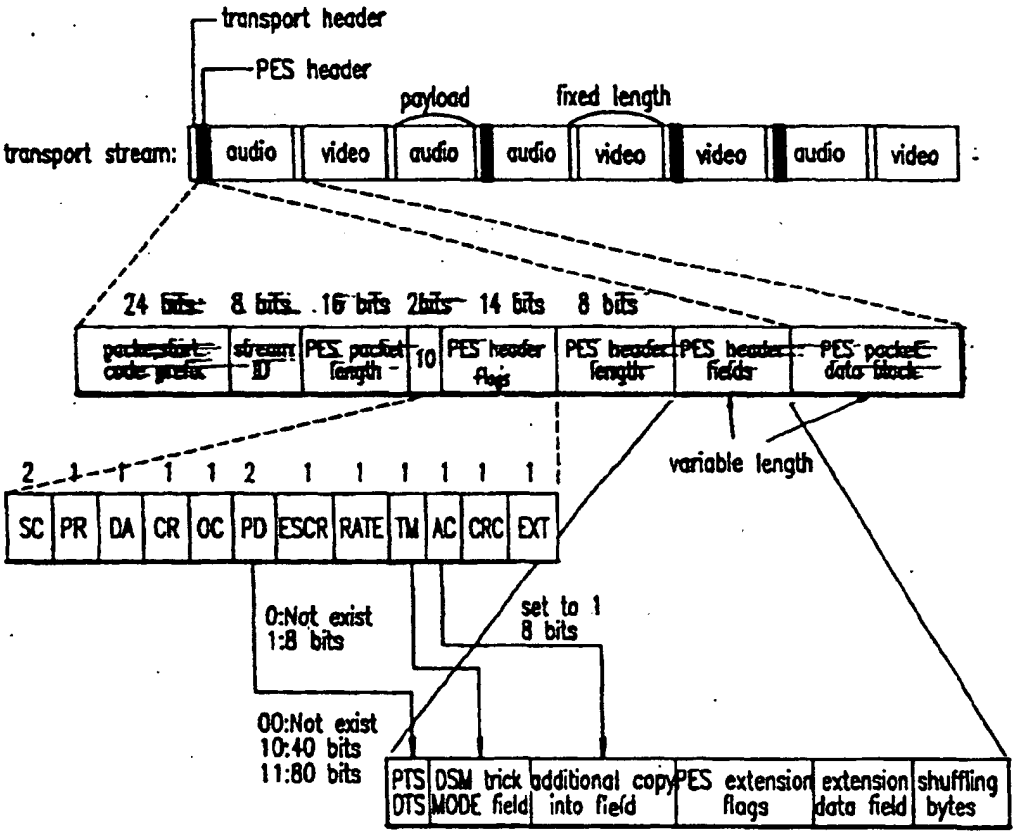


FIG.5
prior art

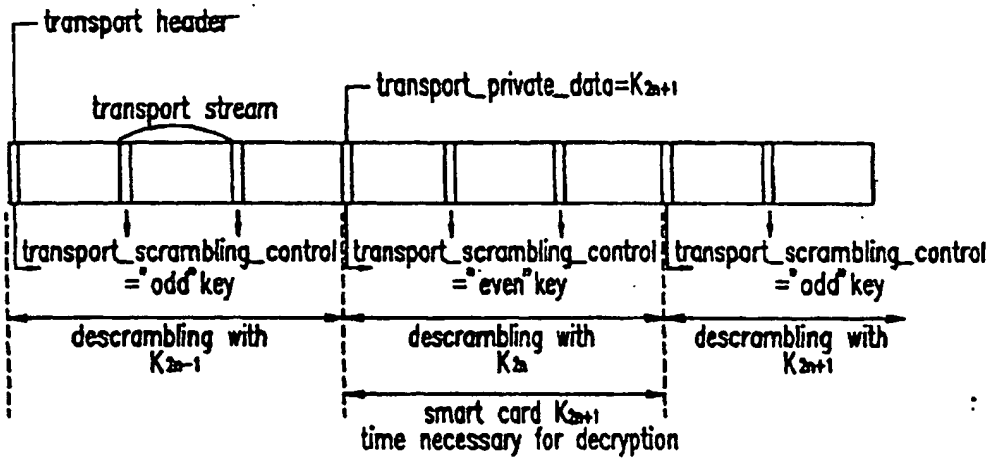


FIG.6
prior art

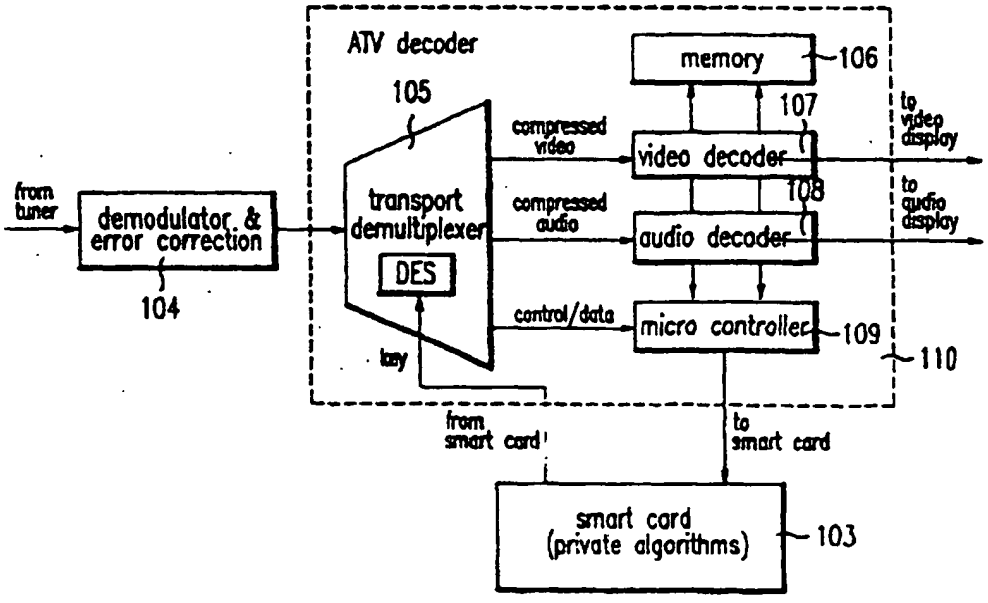


FIG.7

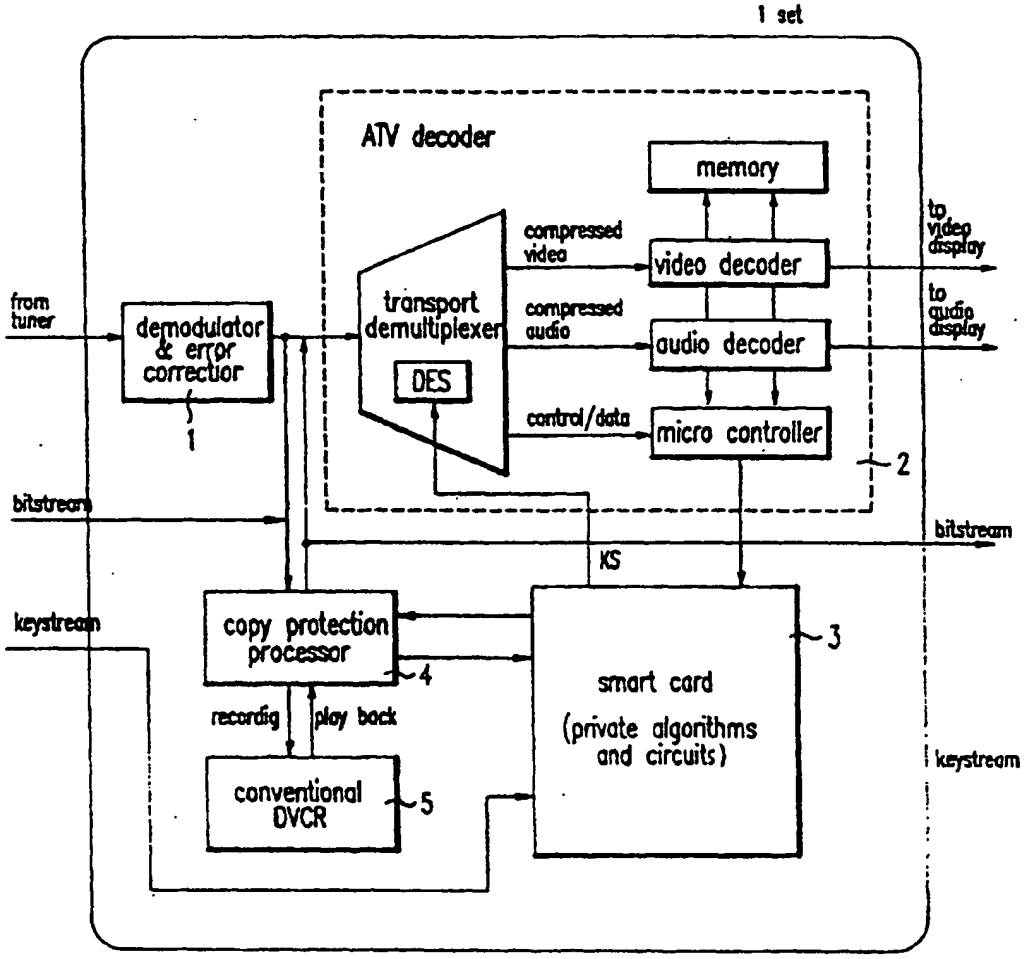

1 set
ATV decoder
memory
compressed video
video decoder
to video display
from tuner
demodulator & error correction
1
transport demultiplexer
DES
compressed audio
audio decoder
to audio display
control/data
micro controller
2
bitstream
bitstream
KS
keystream
copy protection processor
4
3
smart card
(private algorithms and circuits)
recordig
play back
conventional DVCR
5
keystream

FIG.8

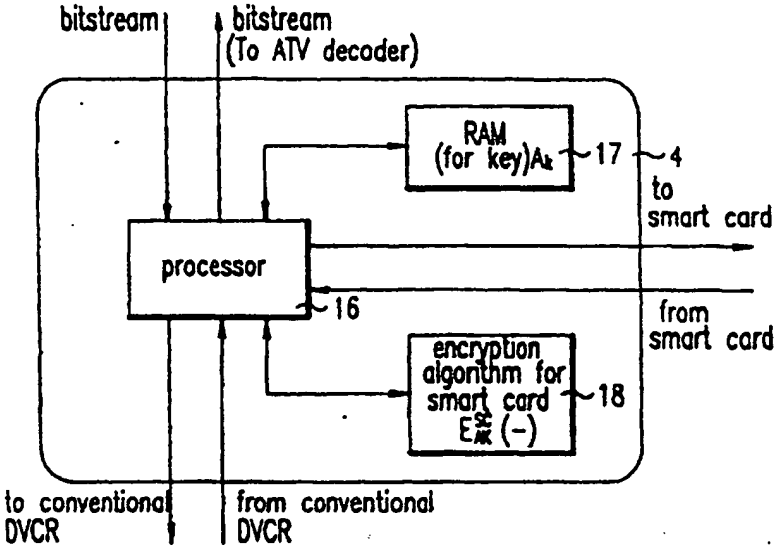

bitstream
bitstream
(To ATV decoder)
RAM
(for key)AL
17
4
to
smart card
processor
16
from
smart card
encryption
algorithm for
smart card
18
to conventional
DVCR
from conventional
DVCR

FIG.9

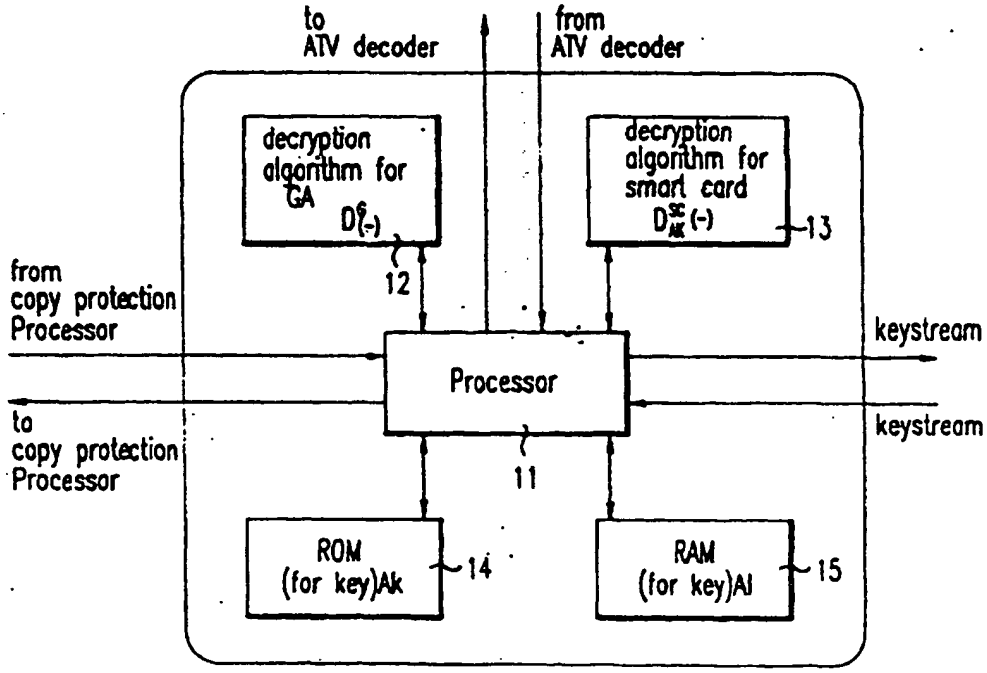

to
ATV decoder
from
ATV decoder
decryption
algorithm for
smart card
13
decryption
algorithm for
CA
12
from
copy protection
Processor
keystream
Processor
to
copy protection
Processor
keystream
11
ROM
(for key)Ak
14
RAM
(for key)AI
15

FIG.10

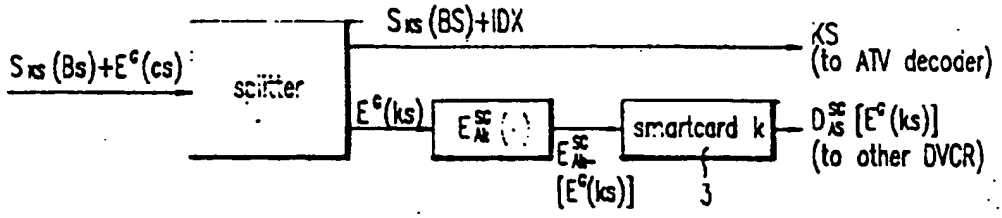


FIG.11a

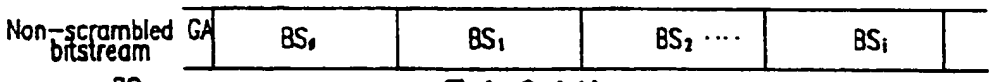


FIG.11b

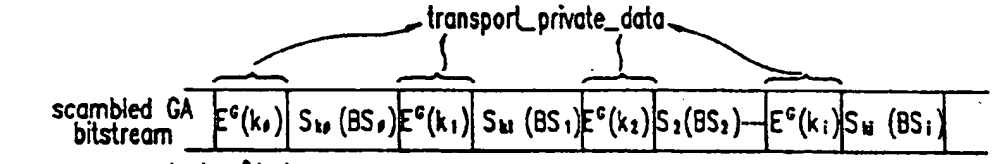


FIG.11c

FIG.11d

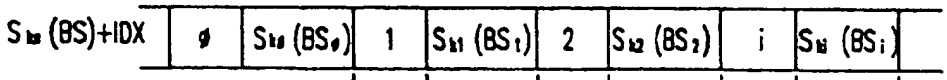


FIG.11e

FIG.11f

FIG.12

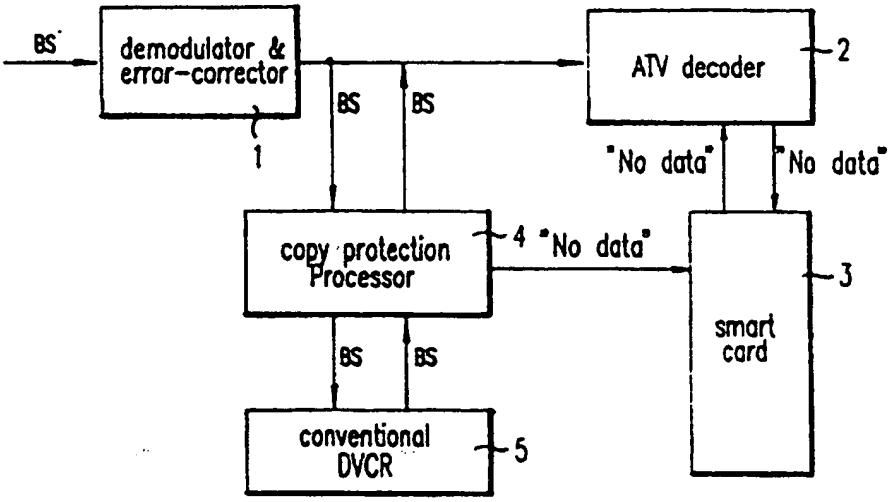

BS
demodulator & error-corrector
1
BS
BS
ATV decoder
2
"No data"
"No data"
copy protection Processor
4
"No data"
3
smart card
BS
BS
conventional DVCR
5

FIG.13

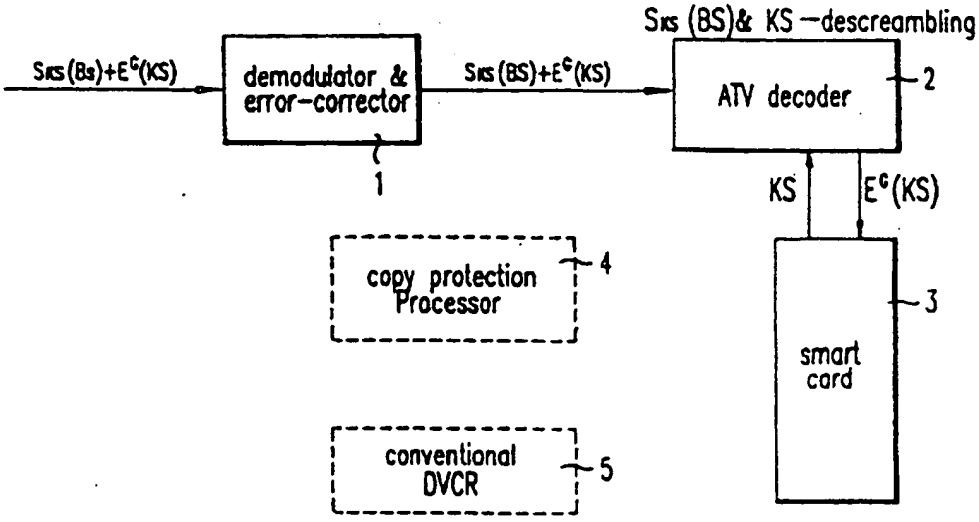

Sks (BS)& KS —descreambling
Sks(Bs)+E^G(KS)
demodulator & error-corrector
1
Sks(BS)+E^G(KS)
ATV decoder
2
KS
E^G(KS)
copy protection Processor
4
3
smart card
conventional DVCR
5

FIG.14

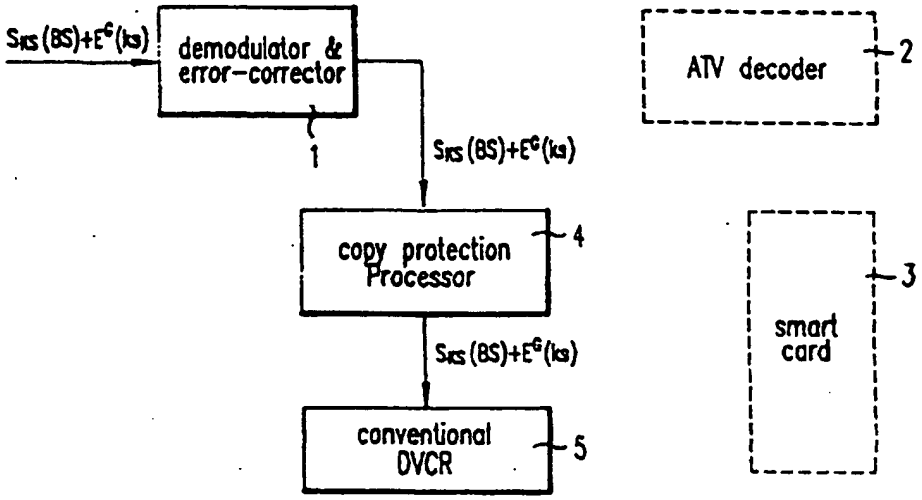

$S_{KS}(BS)+E^{G}(ks)$
demodulator & error-corrector
1
$S_{KS}(BS)+E^{G}(ks)$
ATV decoder
2
copy protection Processor
4
smart card
3
$S_{KS}(BS)+E^{G}(ks)$
conventional DVCR
5

FIG.15

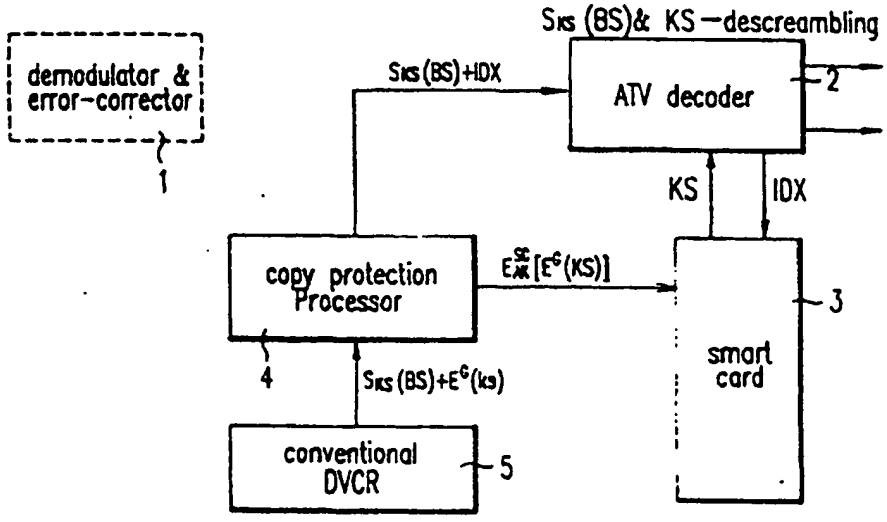

demodulator & error-corrector
1
$S_{KS}(BS)$ & KS-descreambling
$S_{KS}(BS)$+IDX
ATV decoder
2
KS
IDX
copy protection Processor
$E^{SC}_{AK}[E^{G}(KS)]$
3
smart card
4
$S_{KS}(BS)+E^{G}(ks)$
conventional DVCR
5

FIG.16

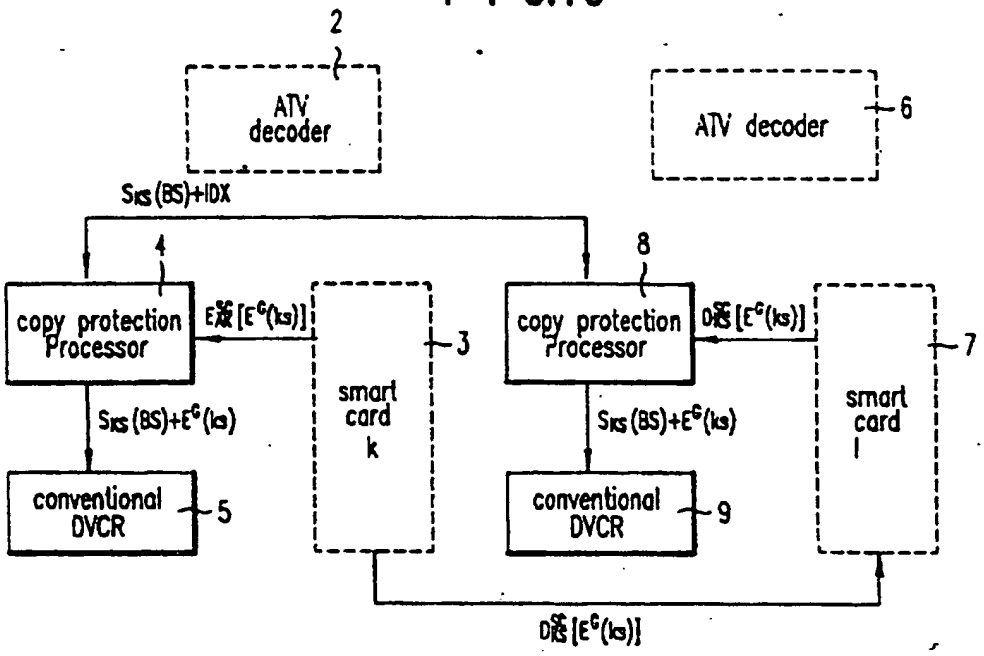

2
ATV decoder
ATV decoder
6
SKS(BS)+IDX
4
8
copy protection Processor
copy protection Processor
3
7
smart card k
smart card l
SKS(BS)+EG(ks)
SKS(BS)+EG(ks)
conventional DVCR
conventional DVCR
5
9

FIG.17

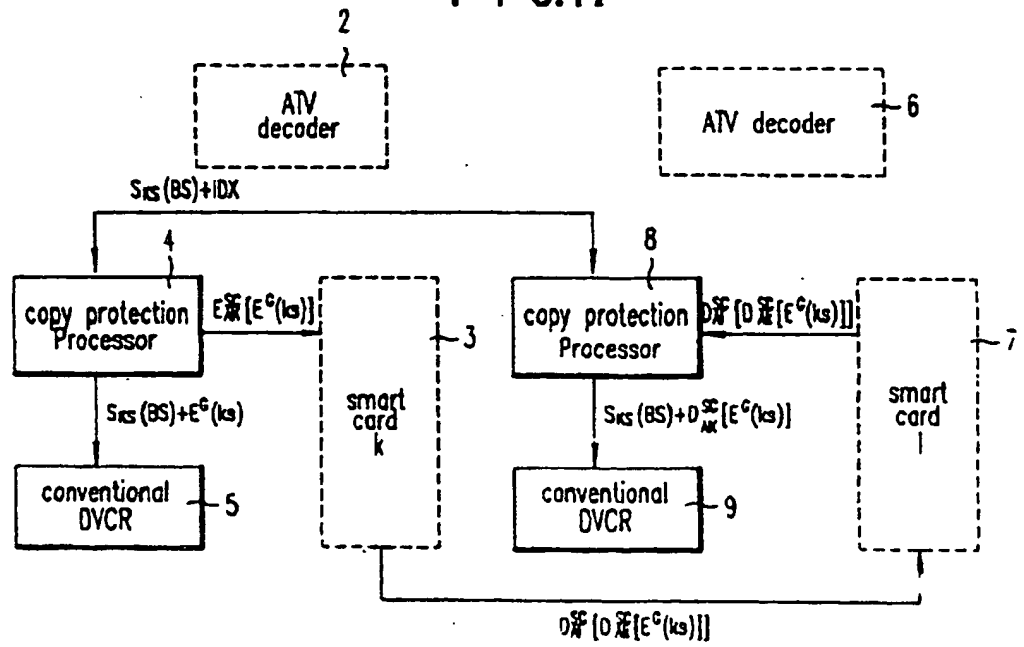

2
ATV decoder
ATV decoder
6
SKS(BS)+IDX
4
8
copy protection Processor
copy protection Processor
3
7
smart card k
smart card l
SKS(BS)+EG(ks)
SKS(BS)+DAK[EG(ks)]
conventional DVCR
conventional DVCR
5
9

FIG.18a

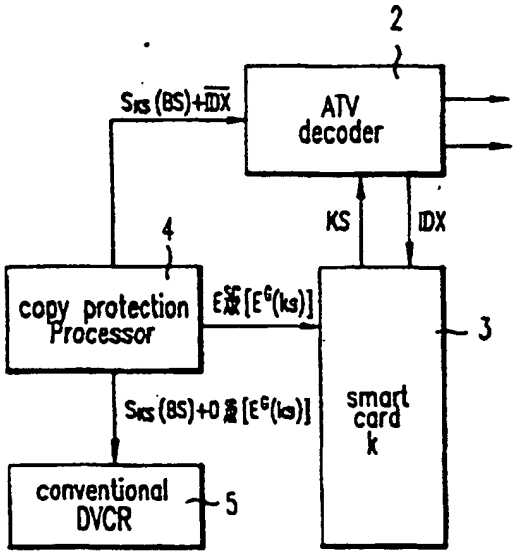


FIG.18b

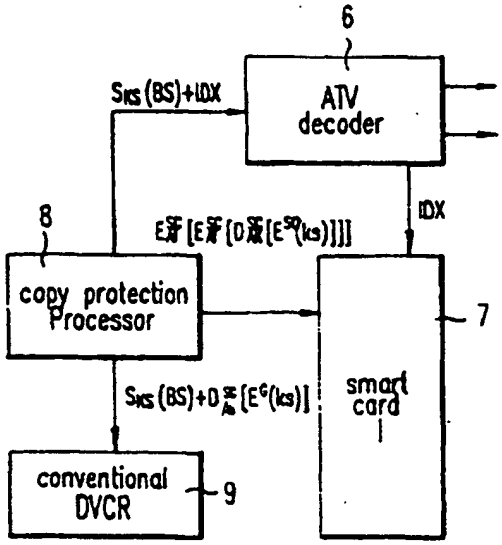
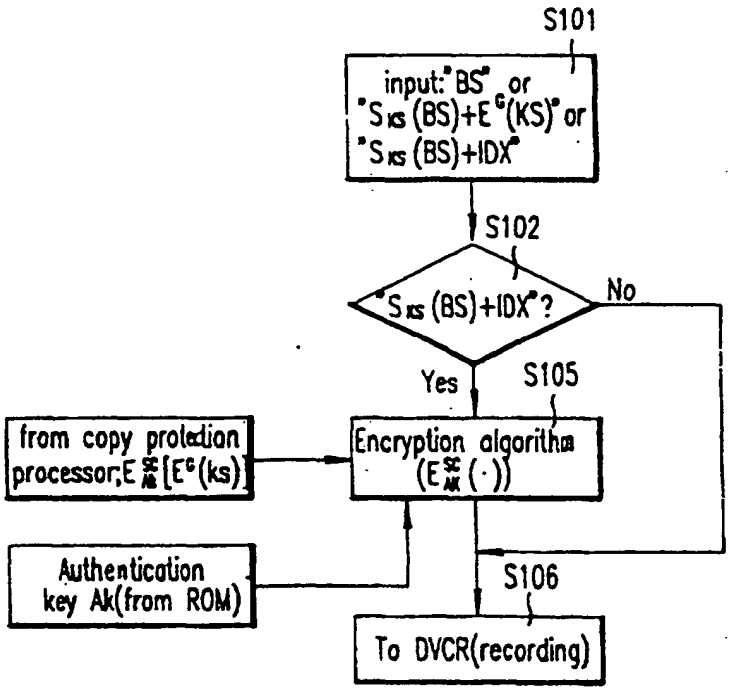
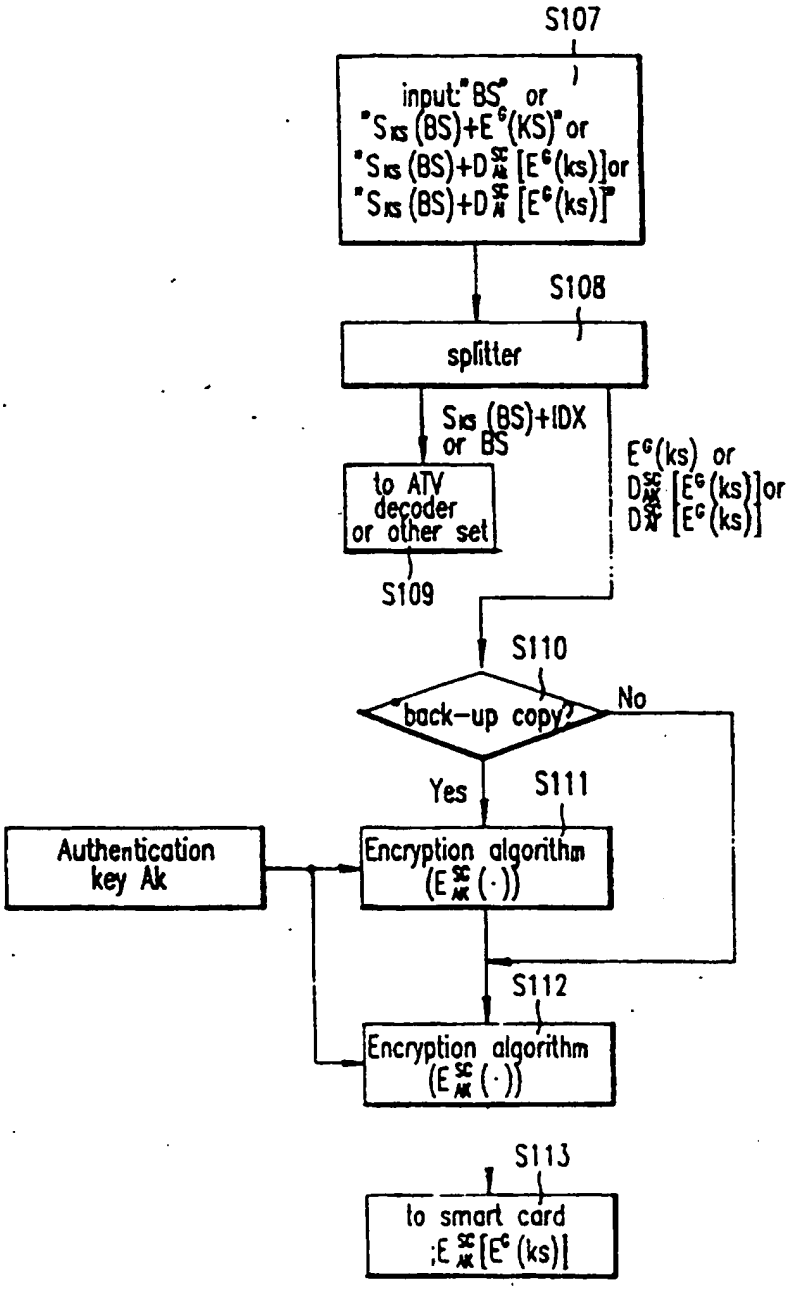


FIG.19a


S101
input:"BS" or "S_KS(BS)+E^G(KS)" or "S_KS(BS)+IDX"
S102
"S_KS(BS)+IDX"?
No
Yes
S105
from copy protection processor;E_Ak^SC[E^G(ks)]
Encryption algorithm (E_Ak^SC(·))
Authentication key Ak(from ROM)
S106
To DVCR(recording)

F I G.19b


S107
input "BS" or
"SKS (BS)+EG(KS)" or
"SKS (BS)+DSCAK [EG(ks)]or
"SKS (BS)+DSCAK [EG(ks)]"
S108
splitter
SKS (BS)+IDX
or BS
to ATV
decoder
or other set
S109
EG(ks) or
DSCAK [EG(ks)]or
DSCAK [EG(ks)]
S110
back-up copy?
No
Yes
S111
Authentication
key Ak
Encryption algorithm
(ESCAK(·))
S112
Encryption algorithm
(ESCAK(·))
S113
to smart card
;ESCAK[EG(ks)]

F I G.20

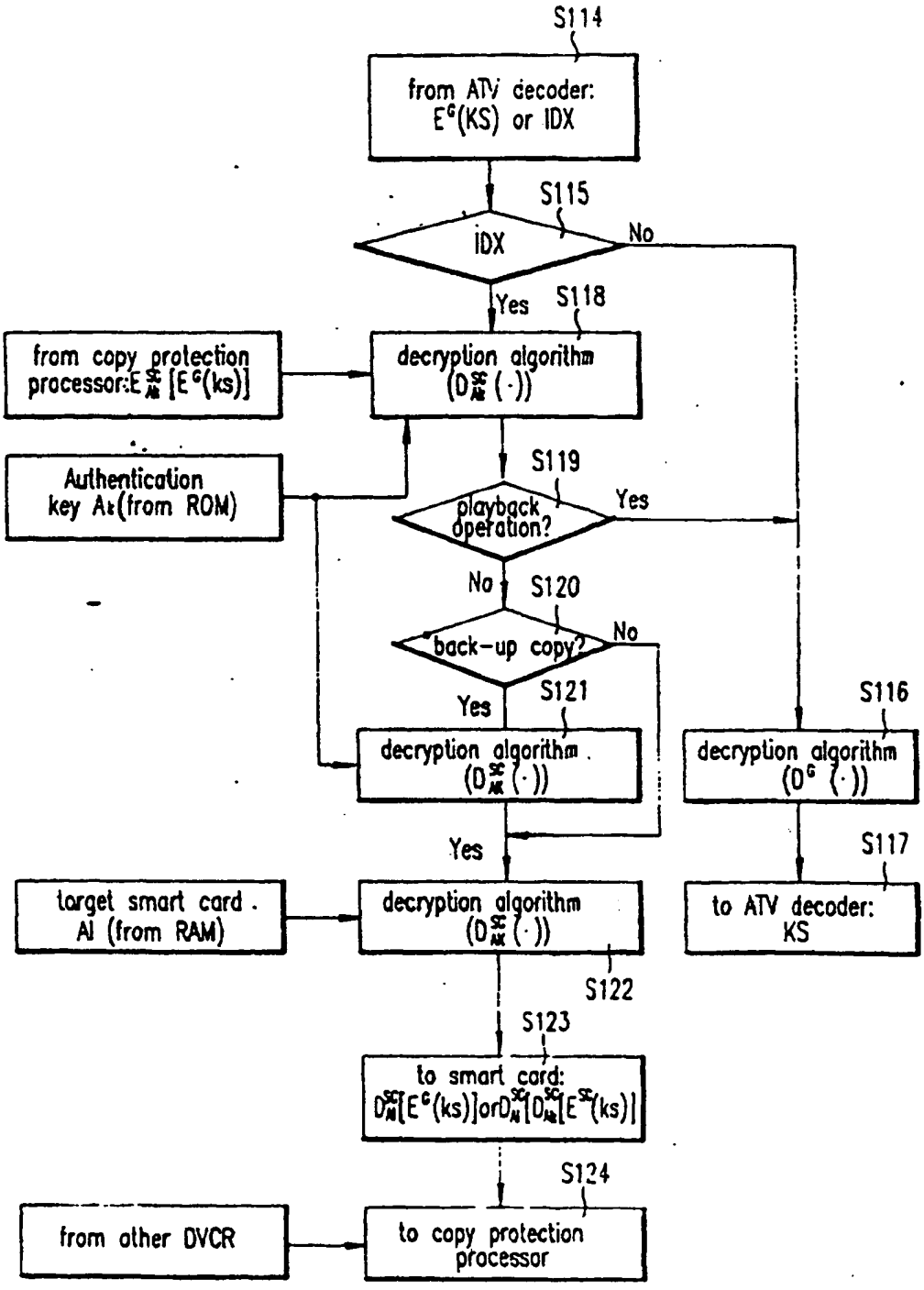
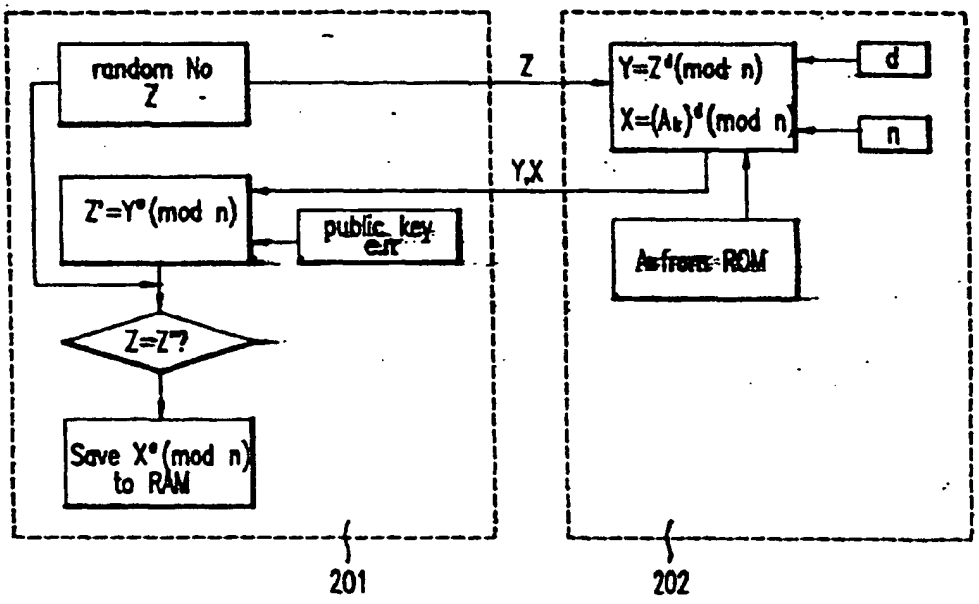

S114
from ATV decoder: $E^G(KS)$ or IDX
S115
IDX
No
Yes
S118
from copy protection processor: $E^{SC}_{Ak}[E^G(ks)]$
decryption algorithm $(D^{SC}_{Ak}(\cdot))$
Authentication key Ak (from ROM)
S119
playback operation?
Yes
No
S120
back-up copy?
No
Yes
S121
decryption algorithm $(D^{SC}_{Ak}(\cdot))$
S116
decryption algorithm $(D^G(\cdot))$
Yes
S117
target smart card . Al (from RAM)
decryption algorithm $(D^{SC}_{Ak}(\cdot))$
to ATV decoder: KS
S122
S123
to smart card: $D^{SC}_{Al}[E^G(ks)]$ or $D^{SC}_{Al}[D^{SC}_{Ak}[E^{SC}(ks)]]$
S124
from other DVCR
to copy protection processor

FIG.21


random No Z
Z
Y=Z^d(mod n)
X=(A_k)^d(mod n)
d
n
Y,X
Z'=Y^e(mod n)
public key e,n
A_k from ROM
Z=Z'?
Save X^e(mod n) to RAM
201
202